APRIL, 1936.

GENERAL PHYSICS.

ADSORPTION.

1386. Lifetime of Particles in the Adsorbed State. D. Blochinzew and S. Schechter. *Acta Physicochimica,* 3. 6. *pp.* 767–778, 1936. *In German.*—The lifetime of particles in the adsorbed state is calculated by the quantum-mechanical perturbation theory. The formula for the lifetime so obtained is valid provided that the mass of the particle in question is small in comparison with the mass of the particles of the adsorbent. An estimate of the zero-point energy of an adsorbed particle is also made. L. A. W.

1387. Adsorption Isotherms. Critical Conditions. R. H. Fowler. *Cambridge Phil. Soc., Proc.* 32. *pp.* 144–151, *Jan.,* 1936.—Reference is made first to Frankel's discussion of the critical conditions. Attention is confined to a monomolecular film because its formation and reasonable completion are fundamental for later layers to occur and the critical conditions can be correctly described in terms of it alone. The adsorption can be expressed as $\log(\mathrm{A}p) = \log \theta/(1-\theta) - (\chi_0 + \theta_{x_1})/k\mathrm{T} = \mathrm{P}(\theta, t)$ where $\mathrm{A} = \mathrm{A}(t)$ is a slowly varying function of the temperature whose variations are unimportant and can be neglected. The function $\mathrm{P}(\theta,t)$ exhibits the critical behaviour if $\chi_1 > 0$. Its behaviour for $\chi_0 = 0$ and $\chi_1/k = 0$ is shown by a series of curves. For a certain value of p typical critical conditions occur very similar to those observed. The change over point is determined and rough values are obtained for Cd vapour which agree with theory. [See Abstract 2319 (1935)]. R. S. R.

1388. Adsorption at the Interface between Two Fluids. Part I. C. W. Gibby and C. C. Addison. *Chem. Soc., J. pp.* 119–127, *Jan.,* 1936.—The adsorptions of specially purified methylene blue, methyl orange, Congo red, and orange-II from various concentrations of each in water, at water-benzene and water-chlorobenzene interfaces, near 17°, and the interfacial tensions of the systems are measured. Full data and concentration-adsorption curves are given. Gibbs' equation, connecting the surface excess of solute, the interfacial tension, and the potential of the adsorbed component, applies only to the adsorption of a single component from a solution in which its behaviour is ideal with reference to concentration, and to interfaces unaffected by electrical charges. Results show marked deviations from the predictions of this equation, the discrepancy being due to interference with one or all of the above conditions. Two types of curve, one having the qualitative features of a Gibbs curve, are found, differing according to the adsorbate but independent of whether the interface is water-benzene or water-chlorobenzene. It has not been possible to correlate clearly the contrast between the two types with any structural features of the molecules. N. M. B.

1389. Adsorption of Hydrogen and Deuterium by Active Nickel. A. Magnus and G. Sartori. *Zeits. f. phys. Chem.* 175. *Abt. A.* 5. *pp.* 329–341, 1936.—The rate of adsorption of H_2 and D_2 by active Ni at 0° and 25° is followed by change in pressure and by the heat evolved at the initial pressures which rise from $\frac{1}{4}$ mm. to $1\frac{1}{4}$ mm. The measurements show that the gas adsorption can be clearly divided into two distinct processes and that only the faster process is calorimetrically effective. The molecular heats of adsorption show the expected values and dependence on pressure. Their dependence on temperature is small. The rate of adsorption of H_2 is very much greater than that of D_2. J. K.

1390. Sorption of Bromine and Iodine by Activated Charcoal. L. H. Reyerson and A. E. Cameron. *J. Phys. Chem.* 40. *pp.* 233–237, *Feb.*, 1936.—Data are given (1) for the sorption of Br_2 by activated charcoal at 58°, 98·1°, 137·6°, and 178·4° C. (2) for the rates of adsorption and desorption of Br_2 by charcoal at 137·6° C.; and (3) for the sorption of I_2 by activated charcoal at 178·4° and 218·8° C. [See Abstract 1885 (1935).] AUTHORS.

1391. Heat of Sorption of Solvents by Nitrocellulose. V. Kargin and S. Papkov. *Acta Physicochimica*, 3. 6. *pp.* 839–856, 1936. *In German.*—The formation of organosols by nitrocellulose during its dissolution in organic liquids is found to be a somewhat complex phenomenon. The sorption of acetone and pyridine by nitrocellulose from mixtures of the solvents with petroleum ether is investigated and the heats of sorption and the isotherms are ascertained. It is found that both solvents give additive chemical compounds of composition: 1 molecule of solvent per molecular group ONO_2. Almost the whole of the energy of combination is due to the formation of the additive chemical compound. The binding forces between the solvatised particles are very small while the transformation sol $\rightleftarrows$ swollen gel has insignificant effects. H. H. Ho.

1392. Adsorption at Crystal-Solution Interfaces. W. G. France and Phoebe P. Davis. *J. Phys. Chem.* 40. *pp.* 177–185, *Feb.*, 1936.—The chief purpose of the paper is the determination quantitatively of the relation between concentration of impurity in solution and the amount of impurity adsorbed by a crystal grown spontaneously under equilibrium conditions. Alkali halide crystals grown in the presence of urea as impurity are selected. Nitrate and alum crystals are grown in the presence of dyes. No relation is found between the number of colloidal particles of dye present in solution and the amount of dye adsorbed by a given host crystal. X-ray powder photographs show the same lattice constants for pure and impure crystals. Dichroism observed in crystals containing adsorbed dye is explained by the assumption that the dye molecules are oriented with respect to themselves and the face on which they are adsorbed. The dye molecules are probably adsorbed with their long axes perpendicular to the cube faces of the alum crystal. The data for the adsorption of dye are reproduced over most of the range by the equation: $a = Kc^{1/n} - K'c^{-1/n'}$. The second term in the right-hand member indicates the occurrence of a counter-adsorption process. At high values of "c" an adsorption isotherm would fit the data but precipitation of the dye partially at higher concentrations negatives this assumption. S. G. B.

1393. Adsorption by Diatomaceous Filters. E. J. Hoagland and J. E. Rutzler, Jr. *J. Phys. Chem.* 40. *pp.* 215–221, *Feb.*, 1936.—It is found extremely difficult, in removal of mother liquor from a crystalline solid, to draw air through a Berkfield filter candle of medium pore size, by means of a vacuum pump after it is wetted by the aqueous mother liquor. After washing the filter with acetone it passes air readily although the acetone does not dissolve out a determinable amount of solid. The present paper shows that: Diatomaceous earth adsorbs water strongly. Berkfield filters of the same rating vary in performance when wetted with water, probably because the diatoms are crushed to different degrees. Salts are adsorbed by diatomaceous earth; sodium thiocyanate is less strongly adsorbed than sodium nitrate and sodium sulphate solution gives a strong negative adsorption. Organic liquids tested are adsorbed less than water. In conclusion it is shown that certain pore size determinations on ultrafilters are defective and a method is suggested for evaluation of Berkfield filters for bacteriological work. S. G. B.

1394. Adsorption and Diffusion in Zeolite Crystals. A. Tiselius. *J. Phys. Chem.* 40. *pp.* 223–232, *Feb.*, 1936.—The use of zeolites for water softening processes is well known. The present paper discusses the mechanism of adsorption and diffusion of water in the crystals of silicates of Ca, Na and K with some Al in their anion structure. The theoretical considerations of Langmuir for adsorption are shown to be applicable. The isotherms obey Langmuir's law quite well up to an adsorbed quantity of definite value in each case, and the heat of adsorption calculated by the Clapeyron equation from isotherms is constant over a wide range. With regard to the interaction between adsorbed molecules, etc., experimental and calculated values agree well, and with regard to the nature of the binding forces evidently the molecule is held in a sort of "dipole hole" and therefore in a strong electrostatic field. Apparatus is described for the determination of factors concerning the mechanism of the kinetics of adsorption and diffusion. The results show that the migration of the water molecules in the crystal follows the ordinary diffusion laws for solutions, and that Fick's law is valid. The diffusion constant is strongly dependent on the concentration. S. G. B.

1395. Sorption of Acid Sodium Oleate. R. F. Nickerson. *J. Phys. Chem.* 40. *pp.* 277–286, *Feb.*, 1936.—The kinetics of "sorption" at the interface between sodium oleate solutions and hydrocarbon oils, including xylenes, toluene, benzene, *n*-bexane, *n*-heptane, *n*-octane, *n*-nonane, *n*-decane and kerosene has been investigated. Values of the sorption potentials and conductance increments of the oils are given. Failure of Gibbs' equation to explain the results is attributed to inadequate knowledge of the processes involved. Inflexion points and negative slopes in the surface pressure-concentration relationship for sodium oleate are probably due to changes in the solute. Changes of surface structures not covered by the theory of orientation probably take place during, and as the result of, adsorption. There is probably a molecular reorientation in the surface configuration of some oils at the plane of contact. Selective adsorption of acid sodium oleate by hydrocarbon oils alters the surface pressure by an amount not predictable from surface tension data. J. S. G. T.

See also Abstract 1814.

ATOMIC AND MOLECULAR STRUCTURE.

1396. Periods of Natural and Artificial Radioactive Substances. Existence of Layers and Classification of Atomic Nuclei. B. Kwal and Anne Riedberger. *Comptes Rendus*, 202. *pp.* 566–567, *Feb.* 17, 1936.—Examination of the $(p, n-p)$ diagram for all radioactive nuclei for which reliable data are available shows that for nuclei for which $p = 0$–10 and $n-p = -1$ the period decreases, while for those with $p = 10$–18 and $n-p = 0$ it increases with p. This implies the existence of closed layers of protons for $p = 10$ (Ne), and 18 (A). In approximately similar fashion it is inferred that such layers exist for $p = 82$ (Pb), and perhaps for $p = 90$ (Th). [See Abstract 6 (1935).] C. A. S.

1397. Artificial Radioactivity by Neutron Bombardment. I. W. Kurtschatow, G. D. Latyschew, L. M. Nemenow and I. P. Selinow. *Phys. Zeits. d. Sowjetunion,* 8. 6. *pp.* 589–594, 1935.—Radioactivity induced in Pa, Re and Os by bombardment with slow neutrons is examined with a Geiger counter. For Pa, the decay curve shows the existence of 4 half-value periods, those of 15 m. and 12 h. already found by Fermi, together with one of about 3 m. and another of about 60 h. For Re, the period of 20 h. originally found by Fermi is confirmed, together with an additional period of about 85 h. A hitherto unreported activity of about 40 h. is observed with Os. F. C. C.

1398. Efficiencies of Production and Half-Lives of Radio-Carbon and Radio-Nitrogen. S. K. Allison. *Cambridge Phil. Soc., Proc.* 32. *pp.* 179–182, *Jan.,* 1936.—The experiments described are a continuation of those of Cockcroft and others on the production of induced radioactivity by high velocity protons and deutons [see Abstract 530 (1935)]. No evidence is obtained that any substance, of half-life measurable by the counter method used, other than radio-C, is produced by deuton bombardment of B_2O_3 at 520 ± 25 kV. Radio-C is separated by chemical means and its half-life is found to be $21 \cdot 0 \pm 0 \cdot 6$ min. The half-life of radio-N produced by bombardment of graphite with either deutons or protons is found to be $10 \cdot 3 \pm 0 \cdot 3$ min. and this value is compared with those of other observers and with the half-life of the radio-N produced by the bombardment of B with α-particles. Results relating to the efficiencies of protons and deutons in producing radio-C and radio-N are given. W. E. P.

1399. Artificially-Radioactive Elements with Very Short Periods. K. S. Knol and J. Veldkamp. *Physica,* 3. *pp.* 145–146, *March,* 1936.—A method is given for investigating artificially-radioactive elements with very short periods by means of a rotating wheel. This method is applied to the bombardment of lithium carbonate with slow neutrons. There results a half period of $0 \cdot 7$ sec., which is ascribed to the radioactive isotope ${}_3\mathrm{Li}^8$. AUTHORS.

1400. High Velocity Positive Ions. Parts V and VI. Disintegration of Boron, Carbon, Nitrogen and Oxygen. J. D. Cockcroft and W. B. Lewis. *Roy. Soc., Proc.* 154*A*. *pp.* 246–279, *March* 2, 1936.—In Part V the disintegration of B by deutons of energies between 300 and 600 kV is studied. Two homogeneous α-particle groups of range $4 \cdot 5$ and $14 \cdot 7$ cm. for deuton energies of 560 kV are discovered, these groups being assumed to result from transmutations in which ${}^8\mathrm{Be}$ and ${}^9\mathrm{Be}$ are produced. There are also two continuous distributions of α-particles which probably result from the break-up of the nuclear system into three or more particles. The results provide a link between the masses of B and the lighter elements. They also suggest that the mass of ${}^8\mathrm{Be}$ should be slightly greater than that of 2 α-particles. In Part VI the disintegration of C, N and O by deutons is studied. A new α-particle group from C is discovered which probably arises from a transmutation of ${}^{13}\mathrm{C}$ to ${}^{11}\mathrm{B}$, although the energy balance with other reactions is not satisfactory. The energy release in the transmutation of ${}^{12}\mathrm{C}$ to ${}^{13}\mathrm{C}$ with proton emission is determined as $2 \cdot 66 \pm 0 \cdot 06$ eMV, and compared with the energy release in the alternative transmutation in which a positron and a neutron are emitted. It appears that the energy balance of the two branches can only be satisfied if the values given by other workers for positron or neutron energies are reduced. The energies of the two proton groups and of two of the α-particle groups resulting from the transmutation of ^{14}N to ^{15}N and ^{12}C respectively are measured and values for the energy release of 8·53 eMV and 13·22 eMV obtained, which differ appreciably from figures published by other workers. A study of the transmutation of ^{16}O to ^{14}N shows that the energy release is 2·95 eMV, a figure in good agreement with other reactions. These more accurate figures for reaction energies require a slight amendment of Bethe and Oliphant's new mass scale. The chief remaining uncertainty in the scale results from the uncertainty in the reaction connecting C to B. [For Part IV see Abstract 530 (1935).] AUTHORS.

1401. Disintegration of Boron into Three α-Particles. P. I. Dee and C. W. Gilbert. *Roy. Soc., Proc.* 154*A*. *pp.* 279–296, *March* 2, 1936.—The disintegration of B under bombardment by artificially accelerated protons is studied by the cloud track method. Definite proof is obtained that the disintegration takes place in the manner indicated by the equation $^{11}_{5}B + ^{1}_{1}H \rightarrow ^{4}_{2}He + ^{4}_{2}He + ^{4}_{2}He$. The common mode of disintegration is into two particles which proceed at angles of 150° to 180° relatively to one another, the third particle receiving little energy. A theoretical picture of the process, involving the existence of an unstable $^{8}_{4}Be$ nucleus, of very short life, is shown to explain the main features of the distribution of energy among the particles emitted in this process and also in the similar three-body disintegration of B under deuton bombardment. The value $8\cdot7 \pm 0\cdot2 \times 10^{6}$ eV is obtained for the total energy release in the first reaction. AUTHORS.

1402. Abundance Ratio of Potassium Isotopes in Mineral and Plant Sources. A. K. Brewer. *Am. Chem. Soc., J.* 58. *pp.* 365–370, *Feb.*, 1936.—A mass spectrographic technique is described which has made possible an accurate measurement of the relative abundance of K isotopes in most K-containing materials. Most minerals exhibit only small differences in the isotope content. The abundance ratio in general is near $K^{39}/K^{41} = 14\cdot25$. Plant ashes show marked variations in the abundance ratio, the K^{41} content differing between plants by as much as 15 %. Kelp exhibits the most pronounced deviation from the general average. The factors contributing to the variations in the abundance ratio are (1) the variety of plant, (2) age, (3) soil, (4) section of plant. [See following Abstract.] AUTHOR.

1403. Atomic Weight of Potassium in Ocean Water. A. K. Brewer. *Am. Chem. Soc., J.* 58. *pp.* 370–372, *Feb.*, 1936.—The abundance ratio for K isotopes in Pacific Ocean water is measured and found to be $K^{39}/K^{41} = 14\cdot20$. No appreciable variations are observed between samples procured at different localities or at points down to 2500 m. in depth. Variations in the atomic weight of K between the samples computed directly from the abundance ratios are less than ± 0·00026. The value for the atomic weight computed from the observed abundance ratio, using 1·00027 for the conversion factor from the chemical to the physical scale, and the packing fraction of A for that of K is close to 39·094. This value is in close agreement with the value accepted by the Committee on Atomic Weights. [See preceding Abstract.] AUTHOR.

1404. System of Masses of Light Atoms Deduced from Nuclear Reactions Alone. Part II. L. Isakov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 4. 3. *pp.* 141–144, 1935. *In English.*—It is shown that the masses of H^{1} and He^{4} previously deduced [see Abstract 378 (1936)], when corrected by the "chemical" to "physical" atomic weight factor, and, in the case of H^1, for isotope concentration and electrolytic separation, give values in almost exact agreement with accepted chemical atomic weights. Agreement for He^4 is also obtained on the building up of a He nucleus corrected for the packing effect. The values of the masses of the lightest atoms are taken as a basis for the deduction of further atomic masses from nuclear reactions, and from 18 equations atomic masses are deduced from C^{12} to A^{36} which are tabulated together with those from n^1 to B^{11} previously found. Regularities and interpolations in the scheme, and applications of the data are discussed. N. M. B.

1405. Masses of Light Atoms. M. L. Oliphant. *Nature,* 137. *pp.* 396–397 *and* 407, *March* 7, 1936.—The masses of the light elements as far as fluorine are calculated from data given by Aston [*Nature,* 137. *p.* 357, *Feb.* 29, 1936], together with transformation data. The large mass found for the neutron (1·0091) is difficult to reconcile with the hypothesis that the proton and neutron are interconvertible elementary particles. By plotting the departure of the atomic masses from a whole number against the mass-number, interesting deductions are made concerning the stability of several atomic species and the probable existence of helium of mass 5·0125, the only mass-number missing from the list, is predicted. AUTHOR.

See also Abstracts 1436, 1437, 1438, 1486, 1583, 1671, 1679, 1680, 1685, 1704, 1705, 1706, 1707, 1708, 1711, 1712, 1716, 1718, 1735, 1741, 1800, 1819, 1827, 1828, 1845.

COLLOIDS.

1406. Orderly Coagulation of Aerosols. D. Beischer and A. Winkel. *Zeits. f. phys. Chem.* 176. *Abt.A.* 1. *pp.* 1–10, 1936.—Crystals, of colloid dimensions, in which, on cooling, a pyroelectric moment is developed, are precipitated by the condensation of the vapour of aminoazobenzene. The little crystals appear to be strung orderly, like pearls, to the number of about 50. J. S. G. T.

1407. Activity of Ions in Colloidal Solutions. Parts I and II. P. Wassiliew, T. Gatowskaja and A. Rabinowitsch. *Acta Physicochimica,* 4. 1. *pp.* 1–50, 1936. *In German.*—In Part I an account is given of experiments on the ultra-filtration of positive ferric hydroxide sols and the potentiometric determination of the activities of Cl^- and H^+ ions in the resulting solutions. It is found that these activities are nearly constant for the different ultra-filtrates obtained. The activity of Cl^- increases, while that of H^+ decreases, in the order ultra-filtrate, sol, residue, *i.e.*, with increasing concentration of colloidal particles. The product of the activities of the two ions is shown to be practically the same for both ultrafiltrates and residues, so that the requirements of Donnan membrane equilibrium are fulfilled. On the basis of Donnan equilibrium a theory of ultra-filtration is put forward which accounts for the observed regularities. In Part II corresponding experimental results are given for negative sols of WO_3, TiO_2 and V_2O_5, the activity determinations being here confined to the H^+ ion. L. A. W.

1408. Diffusion Potentials and Mobilities of Ionised Gelatin. Part II. Neutral and Alkaline Solutions. E. B. R. Prideaux. *Faraday Soc., Trans.* 32. *pp.* 576–582, *March,* 1936.—The previous work [see Abstract 545 (1935)] is extended to neutral and alkaline solutions of potassium gelatinate. The diffusion potentials are measured against KCl of the same K-ion concentrations. It is concluded that for alkali solutions it is not necessary to employ the complete Henderson equation to calculate the potentials, a simpler expression being more in accordance with the facts. The conductivities are also measured as they enable the mobilities of the gelatin ion to be calculated, and diffusion potentials can be independently computed. The two sets of values for the latter are in fair agreement. The diffusion and ζ-potentials are compared and found to be of the same order and vary in the same way. General agreement is obtained with other workers. C. J. B. C.

1409. Viscosity of Organic Colloids. W. Philippoff and K. Hess. *Zeits. f. phys. Chem.* 31. *Abt.B.* 4. *pp.* 237–255, 1936.—By the aid of fluidity curves, " structure-viscosity " is discussed in connection with viscosity of normal substances. The concentration functions of the material constants are empirically deduced and the various factors influencing these material constants examined. J. K.

1410. Thixotropy and Rheopexy of V_2O_5 Sols. F. Juliusburger and A. Pirquet. *Faraday Soc., Trans.* 32. *pp.* 445–452, *Feb.*, 1936.—By moving certain liquid thixotropic sols, *e.g.*, of V_2O_5, the time of solidification can be shortened. This new effect is named " rheopexy " [see Abstract 3254 (1935)]. The present paper deals mainly with the question how rheopexy is related to ordinary thixotropy, using V_2O_5 sols for practically all the experiments. The V_2O_5 sols contained electrolytes and freshly prepared V_2O_5 sols with amicronic particles are only thixotropic and not rheopectic. Only after the formation of large, needle-shaped V_2O_5 particles do the sols become rheopectic. Not all electrolytes can be used to produce rheopexy, *e.g.*, Li salts and acids can, K and NH_4 salts cannot. It is stated that rheopexy is closely related to coagulation by stirring. J. K.

1411. Dilatometric Investigations on Iron Hydroxide, Gelatin, Methyl Cellulose, Silicic Acid and Viscose. E. Heymann. *Faraday Soc., Trans.* 32. *pp.* 462–473, *Feb.*, 1936.—The volume changes occurring during sol-gel transformations of iron hydroxide, gelatin and methyl cellulose are measured with a sensitive mercury dilatometer, having a limiting accuracy of 0·0002 % of the total volume. The volume of methyl cellulose increases during gel formation ; gelatin decreases in volume. The effect is independent of pH. The thixotropic sol-gel transformation of iron hydroxide gives no change in volume. It is assumed that the volume changes are due to a change in hydration of the colloidal particles. The formation of silicic acid gels from sodium silicate and HCl is also dilatometrically investigated and the volume changes are described and discussed. The maturing of viscose solutions which involves the formation of a gel that undergoes syneresis is also investigated. J. K.

***1412. Application of Chain Weight Loading to Determination of Jelly Strength. I. J. Saxl.** *Physics*, 7. *pp.* 62–66, *Feb.*, 1936.—In view of the importance of simple and precise methods for the determination of jelly strength, a new apparatus is developed which permits the determination of jelly strength in terms of load *versus* compression. Chain weight loading is used for the gradual application or reduction of weight. The impression made in this manner within the gelatin specimen is compensated for by lifting it against the motion of a plunger with the aid of a calibrated micrometer screw. In this manner, it is possible to determine the load *versus* compression characteristics to better than three significant figures. The preparation of the sample has been standardised in such a manner that jelly strength determinations can be carried out at room-temperature. Samples of load *versus* penetration diagrams are given.

The formation of hysteresis loops is also described. The introduction of the term, jell factor, is suggested (A = ½ × breaking load × penetration (gm. cm.). AUTHOR.

1413. Structure and Properties of Thixotropic Gels. B. S. Kandelaky. *Kolloid Zeits.* 74. *pp.* 200–206, *Feb.*, 1936.—The properties of iron hydroxide sols are examined. Excess of alcohol and deficiency of water are conditions favouring instability of these sols. Coagulation of the sols, subsequent to their first coagulation, occurs much more quickly. This is attributed to the presence of particles resembling small rods in structure, subsequent to shaking and liquefaction of the gel. The sol-gel transformation effected by shaking is thixotropic in character and independent of the possible formation or otherwise of a disperse liquid phase above the gel. A small charge on the particles is necessary for the occurrence of thixotropy. The process of coagulation and the converse process are investigated ultra-microscopically. A violent Brownian movement is found to occur in the coagulated gels. A net-like structure of the thixotropic gels, enclosing small liquid drops, is established. J. S. G. T.

1414. Emulsification by Ultrasonic Waves. C. Bondy and K. Söllner. *Faraday Soc., Trans.* 32. *pp.* 556–567, *March*, 1936.—The concentration and the degree of dispersion are determined in emulsions produced by ultrasonic waves under different conditions of time and energy of irradiation; the investigation is extended to emulsions of organic liquids in water and *vice versa*, and of mercury in water and organic liquids, both in the presence and in the absence of an emulsifying agent. AUTHORS.

1415. Research Applications of Colloidal Graphite. B. H. Porter. *Rev. Sci. Instruments*, 7. *pp.* 101–106, *Feb.*, 1936.—It is pointed out that electric-furnace graphite can be produced with a high degree of purity and that it can be further colloidalised. Colloidal graphite can be employed in vacuum technique, *e.g.*, to solve shielding problems against electrical disturbances of an extraneous nature in evacuated systems and also in the production of high vacua as well as to fill minute pin holes in glass. Colloidal graphite films can also be applied to rubber tubing without decreasing the flexibility of the rubber. Graphite films can be employed as guard rings, *e.g.*, in photoelectric cells and in electronic tubes. Many other uses are given. J. K.

1416. Phase Rule in Colloid Chemistry. W. D. Bancroft. *J. Phys. Chem.* 40. *pp.* 43–45, *Jan.*, 1936.—It is submitted that the phase rule can be applied in its ordinary form to reversible equilibrium in colloidal systems provided it is remembered that a solid adsorbent can be treated as a single phase only so long as the number and structure of the individual grains remain unchanged and provided an adsorbed substance or film or a peptised substance is treated as not constituting new phases in the application of the phase rule. J. K.

See also Abstracts 1391, 1440, 1521, 1566, 1716.

CRYSTAL STRUCTURE AND PROPERTIES.

1417. Forces Acting between Atoms and Ions and the Elastic Properties of Crystals. J. A. Wasastjerna. *Soc. Scien. Fennica, Comm. Phys.-Math.* 8. 20. [24 *pp.*], 1935. *In English.*—An empirical expression for the repulsive potential $\psi(r) = 9\cdot 2\cdot 10^5 \dfrac{e^2}{\rho_1+\rho_2}\left(\dfrac{b+\xi^7}{b+46}\right) e^{-10\xi}$ is discussed (in the usual notation). This potential cannot be expressed as an inverse power law, but the above formula gives good results for ions of the rare gas type. [See following Abstract.] F. I. G. R.

1418. Calculation of Physical Properties of Crystals. J. A. Wasastjerna. *Soc. Scien. Fennica, Comm. Phys-Math.* 8. 21. [29 *pp.*], 1935. *In English.*—The empirical expression [see preceding Abstract] is applied to determine a number of properties of the alkali halides; in particular the following: energy, compressibility, elastic constants, frequency, thermal amplitudes, dielectric constant. A number of derived properties are also evaluated. Comparison with experiment is satisfactory. F. I. G. R.

1419. Symmetry of a Crystal Lattice and the States of its Electrons. F. Hund. *Zeits. f. Physik*, 99. 1–2. *pp.* 119–136, 1936.—The qualitative conclusions for electronic term structure are roughly, but not always exactly, the same as those from Brillouin's approximation. It is necessary for the crystal considered to be an insulator. For a Bravais lattice, there must be an even number of electrons per atom, and for other lattices of the same space-group an even number per lattice basis. F. I. G. R.

1420. Crystal Structures with Defect Lattices. L. W. Strock. *Zeits. f. Krist.* 93. *pp.* 285–311, *March*, 1936. *In English.*—Defect structures are those in which each chemically different kind of atom does not occupy alone and completely a definite set of equivalent positions. They are classified into (I) complete and (II) incomplete lattices, according as one variety of particles occupies completely or incompletely its set of positions; (I) and (II) are then subdivided according as one variety of particle occupies, A, only one set of equivalent positions, or more than one; B, all of the same coördinate number; or, C, of different coördinate numbers. Each subdivision is divided (1 and 2) according as the occupation is by one or more varieties of particles. Examples are: IA1 $ZnAl_2O_4$; IA2 $Li_2Fe_2O_4$, p-C_6H_4ClBr; IB1 $MgNi_2$; IB2 Mg(CuAl); IC1 sillimanite; IC2 $MgGa_2O_4$; IIA1 Mg_3P_2, Na-W-bronzes; IIA2 α-Ag_2HgI_4; IIC1 γ-Al_2O_3, γ-Fe_2O_3; IIC2 α-AgI. The lattice disturbances responsible for electrical conductivity, self-diffusion of solids, etc., are due to "zwischengitter" ions forming "microdefect" lattices, the ions being in the symmetrical openings between particles of opposite charge and so occupying, though very sparsely, a definite set of lattice points. C. A. S.

1421. Zero-Point Energy in the Determination of the Structure of Solids. A. R. Ubbelohde. *Faraday Soc., Trans.* 32. *pp.* 525–530, *March*, 1936.—The effect of change of isotopes on the structure of solids is discussed for ionic solids in conjunction with the equation of state of the solid, and for organic solids involving only covalent links in conjunction with the change in minimum distance of approach of the molecules. In some cases the effects should be quite large enough to give definite information on the structure. For ionic solids, the results can be correlated with the distribution of lattice vibrations. For organic solids, the change may lead to the location of C — H bonds in space in some cases. AUTHOR.

1422. Statistical Theory of Superlattices with Unequal Concentrations of the Components. R. Peierls. *Roy. Soc., Proc.* 154*A*. *pp.* 207–222, *March* 2, 1936.—The theory of order and disorder in alloys, as developed by Bragg and Williams and others, contains a function V (s) representing the dependence of the average ordering force on the degree of order already established. This function will differ according to the assumptions made as to the physical nature of the ordering force.

In the present paper it is assumed that the force acts only between neighbouring atoms in the structure. With this assumption the mathematical problem involved can be approximately solved by a method due to Bethe. This method has been generalised to apply to a cubic face-centred structure of composition AB_3 (*e.g.*, $AuCu_3$). The energy and the degree of order have been obtained as functions of the temperature. The results are summarised and discussed. AUTHOR.

1423. Cu-Ag Alloys. E. A. Owen and J. Rogers. *Inst. of Metals, J.* 57. *pp.* 257–266, 1935.—As a result of X-ray examination of Cu-Ag alloys it is found that the phase fields are the same as in the generally accepted diagram of the system. With a precision camera the mutual solubilities of Cu and Ag are determined. At 778° C. the solubility of Cu in Ag is 8·5 % and that of Ag in Cu is 8·4 %. These solubilities decrease to 1·8 % and 1·4 % respectively at 500° C. and to 0·2 % and 0·1 % at 200° C. Extrapolated curves indicate that the metals are almost insoluble in each other at room-temperature. J. T.

1424. Ag-Zn Alloys. E. A. Owen and I. G. Edmunds. *Inst. of Metals, J.* 57. *pp.* 297–306, 1935.—X-ray analysis confirms the existence of the phase fields contained in the generally accepted diagram of the Ag-Zn system but indicates that the positions of the boundaries need readjustment. The boundaries involved are the $(\gamma) - (\gamma + \delta)$, $(\gamma + \delta) - (\delta)$, $(\delta) - (\delta + \epsilon)$, $(\delta) - (\delta + \eta)$, and $(\delta + \epsilon) - (\epsilon)$ boundaries. It is necessary, in view of the results, to redetermine the position of the solidus. J. T.

1425. X-Ray Examination of Heat-Treated Ni-Fe-Al Magnetic Alloys. L. Werestschiagin and G. Kurdjumow. *Techn. Phys., U.S.S.R.* 2. 5. *pp.* 431–434, 1935. *In German.*—The crystal structure of Fe-Ni-Al alloys and their alteration with thermal treatment are examined by means of X-rays. A cubic body-centred lattice with a regular atomic arrangement is observed. The alteration in coercivity does not depend on the separation of dispersed particles from the supersaturated solid solution but is governed by the reactions which occur within the solid solution before the separation of the γ-phase. H. J. H. S.

1426. X-Ray Investigation of Osmiridium. O. E. Swjaginzew and B. K. Brunowsky. *Zeits. f. Krist.* 93. *pp.* 229–237, *March,* 1936. —The structure of the single crystal is thread-like, divided into blocks which are distorted amongst themselves to the extent of ± 10°. [See also Abstract 4770 (1932).] F. I. G. R.

1427. Transformation of Non-Metallic into Metallic Antimony. R. Suhrmann and W. Berndt. *Phys. Zeits.* 37. *pp.* 146–149, *March* 1, 1936.—Non-metallic Sb (so-called) is prepared by the precipitation from the vapour in films a few $m\mu$ thick at very low temperatures. Measurements of the electrical resistance of such films suggest that the " transformation " of the non-metallic into the metallic modification is not concerned with any change of a pre-existent crystalline modification. The " transformation " temperature is lower the greater the thickness of the film. Details relating to the absorption spectra of a thin film of Sb (*a*) deposited at 77° Abs. and then (*b*) heated to 373° Abs. and finally cooled to 77° Abs. are discussed. [See also Abstract 717 (1935).] J. S. G. T.

1428. Oxidation of Metals. Part III. L. L. Bircumshaw and G. D. Preston. *Phil. Mag.* 21. *pp.* 686–697, *March,* 1936.—Measurements are made of the rate of oxidation of molten tin at various temperatures, and a number of initial pressures of oxygen. The rate rises rapidly in the temperature range 400° C.–800° C. At any particular temperature the rate is found to vary greatly from one (similar) specimen to another. The parabolic law observed by a number of workers for the oxidation of solid metals does not seem to be obeyed for molten tin, especially at low and high pressures of oxygen. It therefore appears that the rate of oxidation is controlled by some factor other than the progressive increase in the film thickness. It is suggested that the orientation of the crystals composing the oxide film is a determining condition in the rate of oxidation of the metal. [For Part II see Abstract 4451 (1935).] AUTHORS.

1429. Binding of Excess Potassium in Potassium Halide Crystals. O. Stasiw. *Göttingen Nachrichten*, 2. 1. *Fachgruppe* 2. *pp.* 1–7, 1936.—New absorption centres occur when excess K atoms are introduced into alkali halide crystals containing Tl. These centres can be disrupted either thermally or optically, giving migratory electrons. In both cases the electronic paths can be followed. F. I. G. R.

1430. Anomalous Structures of Fine Crystalline Silica. N. A. Shishacow. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 1. *pp.* 19–22, 1936. *In English.*—Examined electronically ($\lambda = 0\cdot05$–$0\cdot06$ Å) silica glass is shown to consist of deformed crystallites of cristobalite with *a* 6·87, *c* 7·28 Å; pumice of similar crystallites with *a* 6·82, *c* 7·23, (though detailed comparison of the lines implies greater differences than these figures would imply). Similarly a very fine sand consisted of deformed crystallites with *a* 4·735, *c* 5·210 (α-quartz normally having *a* 4·903, *c* 5·393). C. A. S.

1431. Structure of Solid γ-Oxygen. W. H. Keesom and K. W. Taconis. *K. Onnes Lab., Leiden. Comm. No.* 240*d*. *Physica*, 3. *pp.* 141–144, *March*, 1936.—The structure of solid γ-oxygen is determined by means of the X-ray goniometer. In agreement with Vegard, a cubic lattice is found. At 50° K., $a = 6\cdot83$ Å; density 1·32, with 8 molecules per unit cell. The intensities measured agree with the space group T_h^6, as given by Vegard. AUTHORS.

1432. X-Ray Analysis of Dibenzyl Series. Part III. Structure of Stilbene, Tolane and Azobenzene. J. M. Robertson, M. Prasad, and Ida Woodward. *Roy. Soc., Proc.* 154*A*. *pp.* 187–195, *March* 2, 1936. —Stilbene, tolane, and azobenzene form a series of closely similar monoclinic crystals, space group C_{2h}^5 ($P2_1/a$) with four molecules in the unit cells. A quantitative X-ray investigation of stilbene, with absolute measurements of intensities, shows that the four molecules have centres of symmetry which coincide with four of the crystal centres. Two of the molecules have orientations similar to the dibenzyl orientation, and the other two can approximately be derived from them by a rotation of 180° about the *a* axis, and a translation of ½*c*. The resulting structure explains the pseudo-orthorhombic properties, the approximate halvings, and the principal X-ray intensities. It is contrary to a structure previously deduced from magnetic measurements by Krishnan, Guha, and Banerjee, who predicted a twisted and distorted molecule; but it is shown that the new structure is equally capable of explaining the magnetic data. Detailed measurements have not yet been made on tolane and azobenzene, but the preliminary data are sufficient to show that they are both closely similar to the stilbene structure. [For Part II see Abstract 2820 (1935).] AUTHORS.

***1433. Elastic Vibrations of an Anisotropic Liquid. V. Zolina.** *Acta Physicochimica*, 4. 1. *pp.* 85–90, 1936. *In German.*—Fréedericksz and Zolina have already noted a new optical phenomenon [see Abstract

4335 (1933)], which arises in an anisotropic liquid under the influence of a vibrating tuning fork, and a more comprehensive study is now published of it. An optical apparatus is described whereby interference figures of the phenomenon are determined, and in which it is possible to note the vibration directions of the optic axes in the entire preparation. The 3 substances investigated were: *p*-ethoxybenzal-*p*-amino-*α*-methylcinnamic acid ethyl ester, acetoxybenzalazine and dibenzylbenzidine. H. H. Ho.

1434. Movements in Anisotropic Liquids in an Electric Field. W. Fréedericksz and W. Zwetkoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 3. *pp.* 131-133, 1935. *In German.*—There exist two conceptions respecting the orientation of the molecules of nematic anisotropic liquids under the action of an electrical field, *viz.*, (1) the optical observations of Zocher and Friedel, which indicate that the long molecular axis is perpendicular to the field direction thereby pointing to the position of the dipole moment of the molecule being perpendicular to this axis; (2) the Röntgen data of Kast at frequencies lower than $3 \times 10^5 \sim$, which indicate the molecular axis to be parallel to the field. Zocher eventually concluded that the dipole moment was parallel to the length of the molecule and that the field acted upon a molecular swarm, and not upon a single molecule. The authors make a series of observations of the movements in nematic liquids (*e.g.*, *p*-azoxyanisole) at low frequencies which support their previous optical data by a total reflection method, and indicate that the electrical field produces turbulence in the liquid and that the predominant direction of the molecular axes in the moving part of the liquid is parallel to the lines of force of the electrical field. Gezewski and Kast's observations are explained from a consideration of the electrical properties of the molecules. H. H. Ho.

1435. Influence of the Electric Field on the Smectic Meso-Phase. V. Fréedericksz and A. Repiewa. *Acta Physicochimica,* 4. 1. *pp.* 91-98, 1936. *In German.*—The substances investigated are *p*-azoxybenzoic acid ethyl ester, and *p*-azoxycinnamic acid ethyl ester. Near the transition temperature to the amorphous state, a different orientation of the rod-shaped drops of the smectic phase is observed in the weak (up to 100 V per mm.) and in the strong (over 1000 V per mm.) electric fields. In fields of average tension, the drops of the smectic phase are not rod-shaped but possess a more rounded form and their rotational movements are uninterrupted. In fields of high tension, explosions of the rod-shaped drops are frequently observed. On switching off the field and by lowering the temperature, large spindle-shaped focal-conical groups develop which, depending on the weak or strong tension, possess a correspondingly rotated orientation. By continuous temperature change from the solid to the amorphous phase, an arrangement is observed of these conical groups into regular oriented series (the ellipse parallel to the lines of force, the hyperbola perpendicular to them, etc.) and a movement among them, which begins slowly in the direction of the series and then becomes stormy and turbulent. Near the transition temperature to the amorphous phase, the movement ceases and the drops stretch into long rods with their lengths parallel to the field. Photographic illustrations are included. The effect of the field must not be ascribed only to the orientation of the dielectric anisotropic molecules, since this is possible in the magnetic field, but induced polarisation, mechanical movement of the liquid, anisotropy of the viscosity, surface tension and other causes must also be taken into account. H. H. Ho.

1436. Molecular Interactions and the Structure of Liquids. P. Girard and P. Abadie. *Comptes Rendus,* 202. *pp.* 398–400, *Feb.* 5, 1936.—The significance of the time of dipole relaxation in the discussion of the state of a substance, and the relation of that time to the concentration of the dipoles are briefly discussed. Results relating to various solutions are briefly mentioned. It is suggested that it is possible to obtain in this manner a picture of the structure of liquids which supplements results derived from their optical properties. J. S. G. T.

1437. Distribution of Molecules in a Model Liquid. W. E. Morrell and J. H. Hildebrand. *J. Chem. Phys.* 4. *pp.* 224–227, *March,* 1936.—A three-dimensional model molecular assemblage has been constructed permitting a determination of the relative frequency of occurrence of the varying intermolecular distances. The model simulates the expansive effect of temperature. A good approximation is obtained to the distribution of molecules in liquid mercury determined by Menke by the aid of X-ray diffraction. AUTHORS.

1438. Theoretical Diffraction Patterns for Simple Types of Molecular Arrangement in Liquids. J. A. Prins and H. Petersen. *Physica,* 3. *pp.* 147–153, *March,* 1936.—Theoretical diffraction patterns are computed for liquid arrangements corresponding to the following structures: *A* cubic and hexagonal close packed, *B* body-centred cubic, *C* simple cubic, *D* diamond structure. The coordination numbers of these structures are respectively: for *A*, 12; for *B*, 8; for *C*, 6; for *D*, 4. Experimental confirmation is found by taking for: *A* inert gases and mercury, *B* alkali metals, *C* antimony, *D* silica and water. The method of "smearing out" an ideal structure (crystal-lattice) to get the corresponding liquid-arrangement is taken from a one-dimensional model.

AUTHORS.

1439. Hydrated Nitrites of Ba and Sr. J. Bureau. *Comptes Rendus,* 202. *pp.* 307–309, *Jan.* 27, 1936.—From morphological considerations and a study of the equilibrium diagrams concerned it is concluded that rhombohedral $Ba(NO_2)_2 \cdot H_2O$ does not exist although two crystalline forms of this substance are found. Cubic $Sr(NO_2)_2 \cdot H_2O$ is likewise stated to be non-existent. The hydrate $Sr(NO_2)_2 \cdot 4H_2O$ is isolated and found to be cubic. At 15° C. it changes over into $Sr(NO_2)_2 \cdot H_2O$, and becomes hexagonal. J. T.

1440. Atomic Silver in Alkali and Silver Halides. A. Toporec. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 4. 1–2. *pp.* 27–30, 1935. *In German.*—The colouring in alkali halides may be due to either colloidal or atomic silver and each has a characteristic absorption band. It is known that u.v. light produces the atomic Ag in alkali halide solid solutions but such a process is still uncertain in the silver halides. Calculation of the "atomic" absorption wave-length from the Mollwo formula $\nu d^2 = 5{\cdot}02 \times 10^{-1}$ cm.^{2} sec.$^{-1}$ (*d* being the lattice constant) shows that in Ag halides there would be overlapping of the atomic and colloidal absorption bands. There is coincidence between the calculated atomic absorption wave-length and the maximum of the photoelectric effect. Experiments with silver introduced into KBr and KI show that atomically distributed silver does exist here (absorption at 300 $\mu\mu$) —but so also does colloidal Ag (absorption varying from 410 to 490 $\mu\mu$ with varying size of colloidal particles). Calculation of the expected absorption wave-lengths for KCl, KBr and KI with atomic Ag centres gives numbers in close agreement with the observed u.v. absorption. J. E.

1441. Optical Properties of Lithium Fluoride in the Extreme Ultra-Violet. E. G. Schneider. *Phys. Rev.* 49. *pp.* 341–345, *March* 1, 1936.—The absorption coefficient of LiF in the extreme u.v. is measured for 50 crystals produced in the laboratory. The variation in the absorption coefficients for the different crystals is almost as great as that found in natural fluorite although the individual specimens seemed more homogeneous than natural crystals Numerical values of the absorption coefficient are given for the best specimen. The light lost from the transmitted beam on passing through a surface is studied for cleavage and polished surfaces. At short wave-lengths the loss of light is much greater than that expected for specular reflection. Tests with various cleaning agents indicate that at least a part of this loss of light is due to a layer of foreign material adhering to the surface. Considerable gain in transmission especially at short wave-lengths is obtained by careful cleaning of the polished surfaces with a highly volatile solvent followed by heating to a temperature just below red heat. The index of refraction curve for LiF is extended into the Schumann region by a modified minimum deviation method. AUTHOR.

1442. Optical Studies on Organic Crystals. Part I. K. S. Sundararajan. *Zeits. f. Krist.* 93. *pp.* 238–248, *March*, 1936. *In English.*—The principal refractive indices and the directions of the optic axes of single crystals of some aromatic hydrocarbons are studied in detail. The results are discussed with reference to the known structure of the molecules and their positions and orientations in the crystal lattice obtained from X-ray and magnetic measurements. It is found that the plane of the optic axes and the directions of the bisectrices agree with those deduced from the crystal structure. From the crystal refractivities along these directions, the principal optical polarisabilities of the molecules are calculated. An estimate is given of the magnitude of the Lorentz field along different directions in the crystal. AUTHOR.

1443. Electrolysis, Dendrite Growth and Discharge in Alkali Halide Crystals. A. v. Hippel. *Zeits. f. Physik,* 98. 9–10. *pp.* 580–596, 1936.—An examination of the electrolysis of rock-salt at high temperatures using Cu electrodes reveals that the movement of the Cu ions by electron immigration from the kathode may be observed visually if u.v. radiation is employed. Important deductions concerning the ionic and electronic immigration are made from the form and colour of the Cu deposit and, by temporal measurements of the deposit, the average mobility of the ions and electrons may be determined. By applying this process to other alkali halides, it is possible to follow the appearance of different forms of combination and reaction, making use of differences in optical absorption, in temperature susceptibility and in the formation of dendrites. In the presence of electrons, a rapidly growing dendrite appears in rock-salt; at about 570° C. a sudden change takes place from the [100] to the [110] direction; an explanation of this is offered. Owing to the presence of numerous small fluid inclusions in rock-salt, the equipotential lines of force in the crystal are mapped out in a visual manner. The formation and growth of dendrites is described; the growth ends ultimately in discharge. Discharge nodes ("*Funkenknoten*") are observed in a crystal and an explanation is thus obtained of the similar phenomenon observed in the spark discharge in gases. A direct proof is obtained of the electronic (rather than the ionic) nature of the electrical discharge in solid bodies. H. J. H. S.

1444. Plasticity of Deformed Metals. D. W. Konvisarov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* **4. 3.** *pp.* 139–140, 1935. *In German.*—By experiments on deformed Al, Cu and Fe the author confirms that the plasticity of a solid polycrystalline material depends on its internal strain. J. T.

1445. Plasticity of Metal Crystals and its Bearing on Mechanical Properties. G. Wassermann. *V.D.I.* 80. *pp.* 283–287, *March* 7, 1936.—The deformation of metals is brought about by 2 crystallographic processes, translation and mechanical twinning. The beginning of translation and the fracture of brittle crystals are determined by certain simple rules. The properties of polycrystalline materials are frequently determined by crystallographic properties. A number of examples are given to show how knowledge of the properties of single crystals can be of use in the understanding of the properties of working materials. H. J. H. S.

1446. Deformation of Polycrystalline Test Rods. G. Seumel. *Zeits. f. Krist.* 93. *pp.* 249–284, *March*, 1936.—In order to give a topology based on qualitative grounds from observations on the surfaces of Al rods a method is developed which shows how suitable measurements on such rods may be undertaken. The apparatus is described. On the setting out of the formulæ for the analytical treatment of the etched curves difficulties arise through the use of the existing hypotheses on the mechanism of the double slipping. A new statement is brought forward which agrees well with the results of experiment. The investigation of the deformation of the separate crystals through measurement of the contour and through following up the distortion of the etched crystals yields the result that the kind of deformation in the neighbourhood of the grain boundary is the same as with a single crystal, but the magnitude of the distortion is smaller. The distortion in the neighbourhood of the grain boundary is thus not disturbed but only hampered. The formation of the glide bands is thoroughly investigated. Newly occurring glide bands in the neighbourhood of the grain boundary were not observed. The thickness of the glide bands remains constant with increasing deformation but decreases on approaching the grain boundary. The strict moderateness of the deformation at the grain boundary is indicated by photographs of etched curves of the toothed region. J. J. S.

See also Abstracts 1392, 1394, 1588, 1636, 1645, 1667, 1669, 1748, 1749, 1750, 1772, 1810, 1847.

DENSITY

1447. Densities of Carbon Monoxide and Helium. E. Mathias and C. A. Crommelin. *Ann. de Physique*, 5. *pp.* 137–166, *Feb.*, 1936.—A method similar to that previously used for O_2, A, H_2, N_2, Ne, He, and C_2H_4 is now employed for the determination of the densities of liquid CO and its saturated vapour. Values of the critical ratios of the aforementioned substances are tabulated. These are seen to be approximately constant, the extreme values being 3·245 and 3·527 for Ne and C_2H_4 respectively. As the experimental rectilinear diameter for CO is slightly curved, an equation of the 3rd degree is derived for this and the critical ratio and density recalculated. By means of the Clapeyron equation the latent heat of vaporisation is obtained, and from an empirical formula for the latter quantity the difference between the specific heats of the saturated vapour and liquid is derived. Similar data to the above for He are recalculated in the light of more recent work. Since the specific heat of liquid He has been experimentally determined by Keesom, Clusius and (Miss) Keesom it is possible to deduce the specific heat of the saturated vapour. The value so obtained agrees with theory in that it is negative at all temperatures. R. W. P.

1448. Densities and Refractive Indices of Bromoform-Benzene Mixtures. J. L. Whitman and L. Clardy. *Am. Chem. Soc., J.* 58. *pp.* 237–240, *Feb.*, 1936.—Experimental data are given for the densities and indices of refraction of a series of mixtures of bromoform and benzene. Equations are derived for certain property-composition relations and are examined with respect to the ideality of the solution. It is shown that this system conforms very closely to an ideal system with respect to the density-composition relation. Numerical equations are given which may be used in the calculation of either weight per cent or volume per cent from a single density measurement at 30°. The necessity of using great caution in applying straight line functions to ideal systems is emphasised. AUTHORS.

***1449. Precision Pyknometer. S. T. Yuster and L. H. Reyerson.** *Indust. and Engin. Chem.* (*Analytical Edition*). 8. *pp.* 61–62, *Jan.* 15, 1936.—The apparatus described was used to follow changes in composition by density measurements during work on D_2O, and is designed to avoid difficulty in thermostating the liquid and container, evaporation at ground-glass joints, and loss of liquid during filling, and to allow easy and accurate determination of density at definite temperatures. It consists of a form of pipette closed at the upper end by a stopcock and at the lower end, after filling, by a ground-glass cap. The whole is enclosed in a test-tube forming a reservoir from a given level of which the pyknometer is filled by suction up to a mark on the stem. N. M. B.

DIFFUSION AND OSMOSIS.

1450. Diffusion of Hydrogen and Deuterium through Heated Platinum. R. Jouan. *J. de Physique et le Radium*, 7. *pp.* 101–106, *Feb.*, 1936.—A practical method is described for the determination of the efficiency of the diffusion process for the separation of H_2 and D_2 from their mixtures. This is accomplished by measurement of the individual rates of diffusion of pure H_2 and D_2 separately through Pt at different temperatures over a range from 450° to 950°. The rate of diffusion of D_2 at all temperatures is found to be about 3/4 that of H_2. Since the difference is small it is probable that the diffusion process of separation is not likely to give good results. Full details of experiment are given. S. G. B.

1451. Diffusion Isotherms of Binary Mixtures. H. Lemonde. *Comptes Rendus*, 202. *pp.* 468–470, *Feb.* 10, 1936.—The coefficients of diffusion, D, were determined for mixtures of H_2O with MeOH, EtOH, PrOH and *i*-PrOH; $CHCl_3$ with Et_2O, $COMe_2$, and EtOH; C_6H_6 with $CHCl_3$, MeOH, EtOH, and C_6H_{14}; and C_7H_8 with EtOH. In dilute solutions D is proportional to the volume concentration; in solutions of all strengths the diffusion isotherms usually show a minimum, rarely a maximum, and occasionally neither. $D\eta$ (η viscosity) is only constant for very dilute solutions; for other solutions D and η may vary in the same or opposite directions, the variation depending apparently on the polymerisation or power of association of the liquids concerned. C. A. S.

1452. Pore Size, Porosity and Permeability of Filters. H. Ruoss. *Kolloid Zeits.* 74. *pp.* 221–224, *Feb.*, 1936.—For a plate of cross-section Q, thickness l, with n through-going capillaries per $(\text{mm.})^2$, the empty space is $(100\ n.\mathrm{Q}.\pi l d^2)/4 = \mathrm{K}$ (say). This is easily determined experimentally by weighing dry, boiling thoroughly in distilled water to remove entrapped air, and re-weighing wet. By Poiseuille's law the volume of water penetrating this filter under a constant head of x cm. water is $(\mathrm{K}d^2xt)/32\eta l^2$. By experiment this crude form is found valid without correction, notwithstanding obstructions and bends. If $f =$ volume of water delivered per sec. under a constant head of 1 atm. (10 m.), by integration $f = [1000 \log_e (\mathrm{H}/h)]/t$, where t is the time taken for the level to fall from H to h in a subsequent expt., being constant for a given plate; $d = 10^{-4} (32 \cdot 10^5 \cdot \eta \cdot \mathrm{Q}l^2 f/\mathrm{K})^{1/2}$; $n = 1 \cdot 25\ \mathrm{K}^2/\pi\eta \mathrm{Q}^2 l^3 f$. For sands a rapid method can be used. D. R. H.

1453. Diffusion of Water Vapour through Acetyl- and Nitro-Cellulose Membranes. S. Wosnessensky and L. M. Dubnikow. *Kolloid Zeits.* 74. *pp.* 183–194, *Feb.*, 1936.—This paper deals with the behaviour of membranes composed of highly polymerised materials towards vapours and gases, and methods are described for finding the effect of membrane thickness, character of surface, temperature and vapour pressure upon the velocity of diffusion; data are given with respect to water vapour. It is found that a complete absorption of the vapour takes place initially followed by passage through the membrane whose velocity attains a constant value after a given time, from whence onwards a linear relationship exists between time of diffusion (t) and amount diffused (m), *viz.* $m = \mathrm{K}_1 t - a$, where K_1 and a are characteristic constants for the membrane. It was found that $\mathrm{K}_1 = \mathrm{K}_2[pn/(n + \mathrm{N})] + \mathrm{B}$, where K_2 and B are individual constants, p is the vapour pressure, and $n/(n + \mathrm{N})$ is the molecular fraction of the water which determines the water content in the membrane. The following expression was derived from Fick's law: t (time of passage) $= \phi h + \mathrm{A}$, where h is the thickness and ϕ and A are constants. The diffusion velocities of the water vapour through the membrane in two opposite directions are found to be different.

H. H. Ho.

1454. Theory of Diffusion Velocity through Membranes. S. Miyamoto. *Kolloid Zeits.* 74. *pp.* 194–196, *Feb.*, 1936.—A theory of the velocity of diffusion through membranes is developed, which depends on the assumption that only these molecules in the solution can enter the membrane which impinge upon the surface with velocities whose components perpendicular to the surface are greater than a limiting value U_0, and that only those molecules in the hollow space of the membrane can emerge which possess velocities perpendicular to the surface greater than a limiting value U_m. An equation based on the above theory is then derived for the dialysis velocity. H. H. Ho.

See also Abstracts 1393, 1394, 1843.

ELASTICITY AND PLASTICITY.

1455. Centre of Flexure of Non-Closed Thin-Walled Section. L. S. Leibenson. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 4. 1–2. *pp.* 17–20, 1935. *In English.*—An approximate solution to this problem was given by Weber. An exact solution is now obtained mathematically for the case of two concentric semi-circumferences. [See Abstract 77 (1936).] R. S. R.

1456. Stationary State Problem in the Space of the Theory of Elasticity. A. S. Bakaliajev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 4. 6–7. *pp.* 255–258, 1935. *In French.*—Derives the boundary conditions at an infinitely distant boundary such that solutions representing horizontal and transverse elastic perturbations shall contain no terms corresponding to radiation from the boundary. W. S. S.

1457. Fracture of a Curved Rod. A. Lockschin. *Zeits. f. angew. Math. u. Mechanik,* 16. *pp.* 49–55, *Feb.*, 1936.—The general equations for the bending of a rod are first established. The following special cases are then examined: (1) curved beam of circular section, (2) parabolic curved beam having uniform loading with (*a*) constant, and (*b*) variable section; and (3) beam with axis in the form of a catenoid with (*a*) constant, and (*b*) variable section. R. S. R.

1458. Application of Physical Data to High-Pressure Processes. W. K. Lewis. *Indust. and Engin. Chem.* 28. *pp.* 257–262, *Feb.*, 1936.—A study of the more recent values which have been obtained for the critical ration RT_c/P_cV_c reveals an increasing tendency for this to assume a constant value. Its value for all the hydrocarbons which contain more than three atoms per molecule is within 3 % of 3·78. The P.V.T. characteristics of these hydrocarbons are accordingly correlated on a reduced basis, PV/RT being plotted against P/P_c for various values of T/T_c. Existing data for CH_4, C_2H_4 and isopentane are seen to fall within 8 % of these curves. An advantage of this method of correlation is that V_c need not be known provided P_c and T_c are available. It is shown that changes in internal energy are a simple function of V/V_c. Such a curve is drawn for isopentane, and this can be used when solving problems involving the internal energy of all higher hydrocarbons. Curves are also drawn from which the fugacities of hydrocarbon vapours can be derived for known reduced pressures and temperatures. These are of use when dealing with hydrocarbon vapour-liquid equilibria problems. Examples involving applications of the various curves are given, and it is interesting to note that, although primarily intended for hydrocarbons, they can be applied to other vapours such as steam and NH_3 to give data in fair agreement with direct experiment. R. W. P.

1459. Compressibility of Glucose Glass. J. C. Lyman and G. S. Parks. *J. Chem. Phys.* 4. *pp.* 218–219, *March*, 1936.—The coefficient of cubical compressibility of glucose glass at 24° C. is found to be $18 \cdot 8\ (10^{-6})$ atmos.$^{-1}$ for the pressure range 7 — 25 atmospheres. The relatively large intermolecular forces in polyhydroxy substances, such as glassy glucose and liquid glycerol, are indicated by a comparison of the compressibility and expansion coefficients for these and other typical organic compounds. AUTHORS.

***1460. Extrusion Plastometer for Unvulcanised Rubber. J. H. Dillon.** *Physics,* 7. *pp.* 73–76, *Feb.*, 1936.—A new extrusion plastometer for unvulcanised rubber is described. The rubber sample is cut automatically and the extrusion chamber is filled in a single operation. The time of extrusion, which is measured by an accurate elapsed time indicator, is chosen as an index of plasticity. The plastometer is shown to be rugged, simple, and rapid in operation. Data are presented which establish the sensitivity and accuracy of the instrument. The results of the extrusion plastometer are discussed with respect to their correlation with those of the Williams plastometer and the United States Rubber Company shearing disc plastometer. AUTHOR.

***1461. Strain Analyser for Glass Seals. A. W. Hull and E. E. Burger.** *Rev. Sci. Instruments,* 7. *pp.* 98–100, *Feb.*, 1936.—A simple photoelastic method of determining the stress in cylindrical glass seals on wire, which are well annealed and viewed normally to the axis of symmetry is described. To measure the double refraction the seal is placed in a parallel sided cell containing a suitable liquid, between crossed Nicols, or between thin sheets of the new polarising film developed by Land, with its axis at 45° to the plane of polarisation. A thin quartz wedge of about 1/4° angle is inserted between the seal and the analyser. From the appearance of the bands in the field of view the direction and magnitude of the stress can be read off. For convenience in calculating the stresses a graph showing the ratio of the radial and tangential stresses at the surface of the wire to the axial stress for different ratios of glass to wire diameter is given. [See also Abstract 366 (1935).] R. L.

***1462. Detection of Permanent Set in Flat Springs. E. V. Walker and K. L. Beak.** *Journ. Sci. Instruments,* 13. *p.* 96, *March,* 1936.—A machine is designed to determine whether material used for flat relay springs will take up a permanent set on being deflected as a cantilever for many millions of operations, in spite of the fact that the stresses applied are below the elastic limit of the material. AUTHORS.

See also Abstracts 1469, 1481, 1483, 1486, 1564, 1749, 1764, 1773, 1841.

GRAVITATION.

See Abstracts 1501, 1526, 1745, 1746, 1747.

HYDRODYNAMICS AND AERODYNAMICS.

1463. Simple Deduction of Stream Functions. H. Steuding. *Zeits. f. angew. Math. u. Mechanik,* 16. *pp.* 20–22, *Feb.,* 1936.—A general method for the derivation of streamline functions in the case of flow past a body of variable profile and possessing an arbitrary motion is discussed mathematically. The case of an unalterable profile and Lamb's problem of an elliptic cylinder with unalterable profile are discussed as special examples. J. S. G. T.

1464. Bénard-Kármán Vortex Motion in a Rectilinear Channel. P. Schwarz. *Comptes Rendus,* 202. *pp.* 629–631, *Feb.* 24, 1936.—Rosenhead has discussed the stability of a Bénard-Kármán vortex street by the method of small oscillations. The author now discusses the motion resulting from a less general, but finite, type of perturbation, the street being displaced from the axis of the canal. The analysis indicates that under certain conditions the street may oscillate on either side of the axis, may remain on the same side of the axis at all times, or the vortices may strike the walls of the channel. J. S. G. T.

1465. Action of Viscosity in Increasing the Spacing Ratio of a Vortex Street. S. G. Hooker. *Roy. Soc., Proc.* 154*A. pp.* 67–89, *March* 2, 1936.—This paper considers the effect of viscosity upon the distributions of vorticity and velocity in a Kármán vortex street. The influence of symmetrical diffusion of vorticity caused by viscous action is considered with special reference to the amount of fluid pumped back between the vortex rows. The author discusses the problem of the diffusion in water of an infinite street of point vortices arranged initially in the Kármán order necessary for stability. It is deduced that, during a time interval for which a vortex street is known to exist in a perfectly regular manner in water, the diffusion of vorticity has no appreciable effect upon the general speed of translation of the system. Photographs of a vortex street formed in water behind an elliptic cylinder are described. Curves showing the measured values of the periodic velocity distribution are given, and from these estimates of the mean distribution of vorticity are made. From the measured velocity distribution along a line perpendicular to the axis of the street and passing through the centre of a vortex, a rough estimate is made of the ages of the eddies. A comparison of the observed and calculated values of the widening of the centres of rotation shows good agreement. H. H. Ho.

1466. Motion of Disc in a Viscous Liquid. M. Ray. *Phil. Mag.* 21. *pp.* 546–564, *March*, 1936.—In place of the usual calculation for a disc by a limiting process from that of the rotating ellipsoid with the help of the gravitational potential function of the ellipsoid, the problem is solved by satisfying the boundary conditions of the equations of motion by the use of Bessel functions for the motion due to rotation of the disc, the total moment of rotation, the disc moving broadside-on, and the disc moving edgeways. In each case the results agree with those obtained by the conventional method. N. M. B.

***1467. Photographic Study of Moving Gases. C. Chartier and J. Labat.** *Comptes Rendus*, 202. *pp.* 729–730, *March* 2, 1936.—Describes the application of stereoscopic chronophotography, already used in the case of liquids [see Abstract 3333 (1933)] to the study of the flow of gases. Using Al powder illuminated by an arc and hypersensitive photographic plates the authors have been able to obtain good photographs at speeds of flow up to 25 m. per sec. They suggest that the method might be used in the case of phenomena involving both a liquid and a gas (*e.g.*, wave formation). J. W. T. W.

***1468. Measurement of Velocity of Flow in Gases. H. Klumb and T. Haase.** *Zeits. f. techn. Physik*, 17. 2. *pp.* 57–60, 1936.—A velocity meter for use in gases is described which makes use of a hot wire. The temperature changes due to flow of gas past the wire may be observed by means of bimetallic strips, by the changes in length of the wire or by thermoelectric methods. The utility of instruments of this type for rates of flow from 10 cm./sec. to about 10 m./sec. is established by actual experiment. The construction lends itself to the production of a very simple type of portable flow meter. Application of the same principle to the measurement of flow in liquids appears practicable and will be tested later. A. W.

***1469. Accuracy Attainable with the Chattock Tilting Manometer. W. F. Cope and R. Houghton.** *Journ. Sci. Instruments*, 13. *pp.* 83–88, *March*, 1936.—An investigation is made to determine the magnitude and nature of the various corrections which must be applied to the reading of a Chattock gauge when it is used for high precision work. A number of Chattock gauges are connected in parallel and their readings compared when various pressure differences are applied. The results show that while the uncorrected reading is accurate to rather better than ± 1 %, this accuracy can be increased tenfold by applying the corrections. On a 13-in. Chattock gauge filled with water, the higher accuracy is represented by about one division of the wheel: this corresponds to a pressure of 0·00065 in. of water. The sensitivity is a quantity of the same order of magnitude. AUTHORS.

See also Abstracts 1472, 1512, 1563, 1775.

KINETIC THEORY OF MATTER.

See Abstracts 1413, 1494, 1748, 1805.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

*1470. **Influence of Temperature with the Bosshardt-Zeiss Reduction Tachymeter (Redta). W. Schneider.** *Zeits. f. Instrumentenk*, 56. *pp.* 57–60, *Feb.*, 1936.—The Berroth-Cremer temperature coefficient for one instrument gave a value of – 7·2 cm./100 m./10° C., but this value differed from earlier results and from that for another instrument. The temperature change will be affected also by atmospheric pressure and vapour pressure, but these two effects are relatively small. Calculation and laboratory tests showed that the effect of temperature on the glass wedge almost compensated that on the steel lath. Further tests were made, and are described to determine the seat of the temperature correction which is reduced to – 1·0 cm./100 m./10° C. and + 1·3 cm./100 m./10° C. for the two positions of working. R. S. R.

*1471. **Thread Eyepiece Distance Measurer. P. Werkmeister.** *Zeits. f. Instrumentenk.* 56. *pp.* 60–63, *Feb.*, 1936.—Although most sources of error can be reduced to negligible proportions an error of 0·001 m. in measuring the segment of the lath may introduce an error of 0·1 m. in the distance. A procedure is described by which this error may be reduced for distances of 50–80 m. to ± 0·2 or ± 0·3 mm. Examples are given of tests so carried out. R. S. R.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

1472. **Almost Periodic Functions and the Vibrating Membrane. A. S. Avakian.** *J. Math. Phys.* 14. *pp.* 350–378, *Dec.*, 1935.—The purpose of this paper is to illustrate the methods of almost periodic functions of H. Bohr in the solution of certain wave equations. The specific problem treated is that of the circular vibrating membrane with non-uniform mass and tension. Under certain conditions the displacement is an almost periodic function of time. The method employs the finiteness of the energy of the system. This was first employed by C. Muckenhoupt and considered under more general conditions by S. Bochner. The Bibliography at the end of the paper presents only a representative list of works in the field of almost periodic functions.

1473. **Error in Slide Rule Calculations. H. A. Ristau.** *Zeits. f. angew. Math. u. Mechanik*, 16. *pp.* 33–48, *Feb.*, 1936.—Instead of dealing merely with errors of assessment a complete review is undertaken of the possible errors and their influence on the results of calculation and the methods by which the errors to be expected, can be calculated. Errors may arise from inaccuracies in the slide rule itself, in setting, rounding off, interpolation, and in the succession of calculations. The individual errors are dealt with and a mean error found. A comparison of theory and practice is tabulated and shows good agreement for rapid calculations. Finally, the use of the theory for special purposes is given. R. S. R.

1474. **Quantum-Mechanical Theory of Measurement. W. H. Furry.** *Phys. Rev.* 49. *pp.* 393–399, *March* 1, 1936.—In recent notes [see Abstract 4483 (1935)] attention has been called to the fact that certain results of quantum mechanics are not to be reconciled with the assumption that a system has independently real properties as soon as it is free from mechanical interference. The extent of this disagreement is here investigated in general, and in abstract terms. When suitably formulated, such an assumption gives to certain types of questions the same answers as does quantum mechanics; this is true of the formulæ usually given in discussions of the theory of measurement. There exists, however, a general class of cases in which contradictions occur. That such contradictions are not restricted to the abstract mathematical theory, but can be realised in the commonest, physical terms, is shown by the working out of an example. AUTHOR.

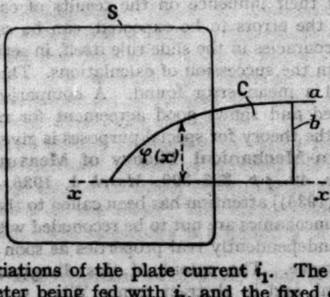
1475. Asymptotic Solution of Linear Differential Equations. H. Jeffreys. *Phil. Mag.* 21. *pp.* 544–546, *March,* 1936.

1476. Derivation of Legendre Function Formulæ from Bessel Function Formulæ. T. M. MacRobert. *Phil. Mag.* 21. *pp.* 697–703, *March,* 1936.

1477. Statistical Information and Properties of Sufficiency. M. S. Bartlett. *Roy. Soc., Proc.* 154*A*. *pp.* 124–137, *March* 2, 1936.—Some preliminary notes on Fisher's concept of statistical information are followed by an examination of its relevance in the small sample theory of estimation, when this is not regarded solely from the standpoint of the reduction of data. Here its relationship with properties of sufficiency seems to be its first justification. These sufficiency properties are extended to cover estimation involving other unknowns, and their bearing on tests of significance of one parameter involving composite hypotheses indicated. AUTHOR.

1478. Dimensions of the Units of Electrical and Magnetic Quantities. P. Andronescu. *Arch. f. Elektrot.* 30. *pp.* 46–57, *Jan.* 28, 1936.—The system of electrical and magnetic quantities has five arbitrary units. The number of different dimensions can be 5, 4 or 3, according as to whether the universal constant C of Maxwell's equations is eliminated or not, and the quantities ϵ_0 and μ_0 are considered as having dimensions or not. P. V.

***1479. Integration of Differential Equations by an Electrical Method. N. Minorsky.** *Comptes Rendus,* 202. *pp.* 293–295, *Jan.* 27, 1936.—A differential equation of the form $d^2\theta/dt^2 + F_1 d\theta/dt + F_0\theta = 0$, where F_1, F_0 are functions of t or θ, may be regarded as the equation of motion of a pendulum having variable parameters. The law of oscillation of such a pendulum as a function of time gives the general integral of the equation. If a solenoid S, carrying an alternating current, i_0, is penetrated along xx by a plane coil C, limited by the x axis, the curve $\phi(x)$, and any third side, there is induced an e.m.f. between the terminals a b which can be applied to the grid of an amplifying valve to produce corresponding variations of the plate current i_1. The moving coil of an electro-dynamometer being fed with i_1, and the fixed coil with i_0 (of the same frequency and phase but fixed amplitude), the differential equation



of motion of the coil is $Id^2\theta/dt^2 + ci_0i_1\theta = 0$, which is of the form (I) where $F_1 = 0$. The desired function is thus introduced as a modulation of i_1. Applications of the method to Schrödinger's and Mathieu's equations are considered. The treatment of equations with F_1 is illustrated. R. E. N.

***1480. Photographic Recording. K. Lüdemann.** *Zeits. f. Instrumentenk*, 56. *pp*. 63–71, *Feb*., 1936.—A summary is given of the advantages of photographic recording in astronomy (stellar and other measurements), meteorology (balloon theodolite) and air track conditions (kinetheodolite). Special appliances with this object for land measurements, for surveying, and determining latitude, longitude and height are discussed and shown to be preferable to older methods. R. S. R.

See also Abstract 1786.

MECHANICS, CLASSICAL.

1481. New Principle of Mechanics. F. H. van den Dungen. *Comptes Rendus*, 202. *pp*. 282–284, *Jan*. 27, 1936.—For a deformable beam on rigid support and in equilibrium under one normal external force F producing displacement y_e of the elastic axis, a formula of Clapeyron gives $\frac{1}{2}Fy_e = A(y)$ where A is the internal potential of flexure. By d'Alembert's principle, if y_e is chosen a value of F can be found for any arbitrary deformation. The minimum of F is found for the true value of y. This principle is applied briefly to oscillations, viscous systems, etc., and is applicable to all systems with linear equations. T. L. M.

1482. Gyroscopic Phenomena. G. Bisconcini. *Accad. Lincei, Atti*, 22, *pp*. 417–420, *Nov*. 17, 1935.—In the motion of a solid about a fixed point or about its centre of mass, when the rotation is round a line very near a principal axis of the solid at the point considered, the two following results are proved: (*i*) the axis undergoes in a certain interval of time an angular displacement, which tends to bring it into the mean of the directions which the moment of the force system assumes in that interval. (*ii*) The force necessary to produce a prescribed motion must have the greater effect the greater the pre-existing velocity is with which the body is rotating round the said principal axis. A. J. McC.

1483. Consumption of Energy and Development of Heat in Oscillating Steel Rods. A. Ono. *Zeits. f. angew. Math. u. Mechanik* 16. *pp*. 23–32, *Feb*., 1936.—The mechanical work is measured and also the heat developed is estimated when a steel rod is subjected either to periodic bending or rotational forces. The theory is shown by which the values of these two quantities are reckoned from the mass, period, temperature and so forth of the moving rods. It is found that for small changes of tension, the heat energy is considerably lower than the mechanical energy, but that as the tension change is increased, the two values become approximately the same. This must be due to some structural change in the rod at low tensions, for higher ones a stationary state is reached. H. M. B.

***1484. Illustration of a Conservation Paradox. R. M. Sutton.** *Am. Phys. Teacher*, 4. *pp*. 26–27, *Feb*., 1936.—A simple apparatus is described for demonstrating two apparently similar cases of rotation. Conservation of kinetic energy of rotation occurs in the first case, accompanied by an unexpected transfer of angular momentum to the earth. In the second case, the angular momentum is conserved while an astonishing increase of kinetic energy occurs. The apparatus emphasises the distinction between the time integral and the line integral of a force. AUTHOR.

***1485. Coefficient of Dynamic Friction. V. E. Eaton.** *Am. Phys. Teacher*, 4. *pp.* 37–39, *Feb.*, 1936.—A student apparatus is described for determining the coefficient of friction between dry solid surfaces by measuring the time required for a block to slide down an incline of known inclination. Automatic switches operate an impulse counter which records the time in terms of the frequency of the a.c. supply. The constancy of the acceleration is checked by a system of spark recording. AUTHOR.

***1486. Impulse Recorder. H. Martin.** *Phys. Zeits.* 37. *pp.* 166–167, *March* 1, 1936.—Curves are given to show the responses of instruments to impressed forces given by an equation of the form $x = \sin kt - \frac{1}{3} \sin 3kt$ acting for a time from $t = 0$ to $t = \pi/k$, where k is the ratio of the period of the undamped driven system to that of the driving oscillations. The instruments may be of the type in which the pendulum remains at rest with respect to the rest of the instrument as in a seismograph, or the type in which the oscillation is shown by the suspended part as in a galvanometer. The instruments may be used either to measure oscillations or accelerations. H. M. B.

MECHANICS, QUANTUM.

1487. Collisions between Neutral Atoms of the Rare Gases. B. O. Grönblom. *Soc. Scien. Fennica, Comm. Phys.–Math.* 8. 13 [9 *pp.*], 1935.—Following a wave-mechanical treatment of Wasastjerna [see Abstracts 2798 and 2800 (1933)], collisions between neutral atoms of the rare gases are examined. The result is in qualitative agreement with previous formulæ and although quantitatively there is disagreement by a factor of 2·8, the discrepancy is not considered serious. F. C. C.

1488. Problem of Two Particles in the Atom. E. Sevin. *R.G.E.* 39. *pp.* 207–219, *Feb.* 8, 1936.—After a survey of the conditions under which the problem of two particles in the atom has, up to now, been treated mathematically, it is shown that an important energy term connected with the acceleration of the proton-electron system has been overlooked. An exact solution which is developed greatly simplifies wave quantisation, and with correct treatment of waves and spin [see Abstract 1453 (1935)] leads to agreement with experimentally observed fine structure, and entirely eliminates the discrepancies between theoretical and experimental results. The solution obtained takes essential account of the neutron, and it appears, regarding the motion of the electron, that as for the interior so for the exterior of the nucleus, the principles of Maupertuis and Fermat are simultaneously and rigorously valid.

N. M. B.

1489. Problem of Three Centres. Part II. G. S. Gordadse. *Zeits. f. Physik*, 99. 3–4. *pp.* 287–299, 1936.—The author's work on the quantum mechanics of the H_3^{++} atom is extended [see Abstract 4480 (1935)]. A general expression for the energy is found and a numerical method is used to determine the extreme values of the energy. The H_2^+ ion is also dealt with and the calculations give good agreement with experiment. Tables for the linear and triangular models of H_3^{++} are given and the instability of these models is demonstrated. G. C. McV.

1490. Exchange Energy in Many-Electron Problems. L. Goldstein. *J. de Physique et le Radium*, 7. *pp.* 141–145, *March*, 1936.—The limits of validity of the analytical expression for the exchange energy in problems concerning many electrons are discussed mathematically.

J. S. G. T.

1491. Conservation of Energy in Atomic Processes. P. A. M. Dirac. *Nature,* 137. *pp.* 298–299, *Feb.* 22, 1936.—The Bohr-Kramers-Slater theory denying the validity of the law of conservation of energy was abandoned following the development of the new quantum mechanics. The recent accurate experiments of Shankland [see Abstract 1241 (1936)] indicate that energy and momentum are conserved in atomic processes in which the velocities concerned are small compared with the velocity of light, but not in processes involving large velocities. This agrees with the fact that the present quantum mechanics is satisfactory only when applied non-relativistically to problems involving small velocities. The non-relativistic quantum mechanics, the primary theory of radiation which treats the electromagnetic field classically as an external perturbing force, and the theory of the spinning electron may be retained, but quantum electrodynamics should be abandoned. N. M. B.

1492. Approximation to the Fermi Distribution Function. S. Rozental. *Zeits. f. Physik,* 98. 11–12. *pp.* 742–745, 1936.—Two functions, approximating to the solution $\phi(x)$ of the equation $\partial^2\phi/\partial x^2 = \phi^{3/2}/x^{1/2}$, subject to the boundary condition $\phi(o) = 1$ and $\phi(\infty) = o$, of the Thomas-Fermi theory are given. The first, ϕ_2, is a linear combination of two exponential functions, the other, ϕ_3, is a linear combination of three exponential functions. The respective solutions are sufficiently good approximations within the respective ranges, $0 < x < 2$, for ϕ_2, and $0 < x < 10$, for ϕ_3. For larger values of x, Sommerfeld's asymptotic solution affords a closer approximation. J. S. G. T.

1493. Wave Geometry. K. Morinaga. *Hiroshima Journ. Sci.* 6. *pp.* 103–113, *Jan.,* 1936.—The conditions for integration of the fundamental wave equation previously deduced [see Abstract 4485 (1935)], and the transformation, solution, and interpretation for special cases are examined. N. M. B.

1494. Space Quantisation. I. I. Rabi. *Phys. Rev.* 49. *pp.* 324–328, *Feb.* 15, 1936.—The effect of a rapidly varying weak magnetic field on an oriented atom possessing nuclear spin is discussed. The results are applied to an experiment by Frisch and Segrè [see Abstract 1749 (1933)]. It is shown that by methods embodying these principles nuclear spin can be measured even when the hyperfine structure separation is very small. A possible further application is discussed whereby it is possible to measure the sign of nuclear magnetic moment vector with respect to the spin vector. AUTHOR.

1495. Properties of the Spin of a System of Particles. J. L. Destouches. *Comptes Rendus,* 202. *pp.* 387–389, *Feb.* 5, 1936.—The system consists of particles obeying the Dirac wave-equation and not interacting with one another. The operators representing the total spin of the system, the spin of the centre of gravity and the spin of the relative motion, respectively, are shown to be identical. It is also shown that when it is possible to separate the relative motion from that of the centre of gravity the spin is associated with one of the two motions only. G. C. McV.

1496. Probability in Wave Mechanics. E. T. Hanson. *Phil. Mag.* 21. *pp.* 572–608, *March,* 1936.—The object of the paper is to obtain the fundamental equations of wave mechanics from the principles of statistical mechanics. The probability of observed occurrence is distinguished from the probability of occurrence, the former denoting that some entity is observed in a given position and at a given time, in the light of Planck's hypothesis, and is shown to be a wave function. The probability of occurrence of a property in a small region of configuration space is proportional to the number, within the space, of points with which the property may be associated; these points if very numerous, being taken to form a continuous fluid. The variable representing the relative probability of occurrence may be visualised as the density of the property in a statistical fluid. The electric charge $-e$ may be associated with each of the cloud of points, and the association of the intensity of the wave with the relative probability of observed occurrence of electric charge is investigated. It is shown that the Schrödinger equation can be obtained from the principles of statistical mechanics. The statistical theory is formulated by applying classical Hamiltonian dynamics to the elementary points of a statistical assembly. The previously vague variables of the wave equation can be defined, and it appears that the imaginary i should be interpreted as a mathematical symbol for non-observability. The theory developed is based on a natural interpretation of Planck's hypothesis in terms of probability, and, by strict adherence to the accepted laws of probability in statistical mechanics, no assumptions are required. N. M. B.

1497. Statistical Theory of Neutral Atoms. P. Lal and K. Lal. *Indian Journ. Phys.* 10. *pp.* 1–6, *Jan.*, 1936.—The binding energy of the atom is calculated in an elementary way on the Thomas-Fermi statistical model by neglecting the interaction between the extra-nuclear electrons. The values of the energy so obtained are compared with those calculated by Jensen and Hartree, and a good agreement is found for not very heavy atoms. An expression for the radius of the neutral atom is also obtained. AUTHORS.

See also Abstracts **1474, 1580, 1630, 1631, 1738, 1750, 1860.**

RELATIVITY AND ETHER.

1498. Light and Gravitation. F. Tavani. *Phil. Mag.* 21. *pp.* 564–572, *March*, 1936.—If the origin of a reference frame describes a curve in two-dimensional space, a relativistic equation is found for the velocity of a luminous point with reference to axes T and N of the moving frame on the tangent and normal, respectively, to the curve described by the origin; this equation contains quantities called, by analogy with the accelerated motion of a falling body, the acceleration of light along T and N [see Abstract 4866 (1935)]. The law of motion of a luminous point along N coincides within realisable circumstances with that of the fall of a heavy body. In view of this identity the law of gravitational motion is investigated with reference to moving frames, and it is shown that, from the interpretation of our physical space as a space of orbits or a space-time of six dimensions, we pass to the meaning of gravitation as the form of the natural motion, free from forces, in such a space. N. M. B.

1499. Relativistic Problem of Motion in a Stationary Gravitational Field. E. Gugino. *Accad. Lincei, Atti*, 22. *pp.* 405–411, *Nov.* 17, 1935.—The motion of a material point in a gravitational field, whose relativistic ds^2 is of the form:

$$ds^2 = (1 - 2\phi)c^2dt^2 - 2\,c\,dt\left(\sum_1^3 \gamma_i dx^i\right) - (1 + \chi)\left(\sum_1^3 dx^i dx^i\right),$$

the functions $\phi, \chi, \gamma_1, \gamma_2, \gamma_3$ being independent of t, is here considered. It is proved that the relativistic motion of the particle, between two assigned positions A and B and for a prescribed value of the energy E, is that curve of the ordinary Euclidean space which gives a stationary value for the curvilinear integral

$$\int_A^B \{\sqrt{2(c^2\phi + E)(1 + 2\phi + \chi)} + c \sum_1^3 \gamma_i dx^i/ds_0\} ds_0.$$

If the γ's are equated to zero, a well-known theorem due to Levi-Civita is obtained. A. J. McC.

1500. Stability of a Particle in a Gravitational Field. V. V. Narlikar. *Roy. Astron. Soc., M.N.* 96. *pp.* 263–266, *Jan.*, 1936.—In a gravitational field, the conditions which must be satisfied at a point by the $g_{\mu\nu}$ so that the motion of a particle should be stable in the neighbourhood of the point are found. The resulting definition of stable or unstable motion is relative to the coordinate system chosen. In the spherical or hyperbolic universes of variable radius it is shown that, if cosmic time be the independent variable in the equations of motion of a particle, then every point in the universe is one of stable motion provided that the radius of the universe is expanding, but not otherwise. G. C. McV.

1501. Gauss' Theorem in General Relativity. J. T. Combridge. *Phil. Mag.* 21. *pp.* 708–709, *March*, 1936.—A correction. [See Abstract 4868 (1935).]

1502. Unitary Theory of Field and Matter. Part I. M. Born. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 8–24, *Jan.*, 1936.—A new derivation of the equations of motion of a charged particle is given on the basis of the classical Maxwell equations for the field. The chief assumption is that the field approaches a constant value at great distances from the particle. The Dirac δ-function is made use of in the definition of the singularity representing the particle. The spin enters naturally into this theory. Kramer's equations for a spinning particle are derived from this unitary field theory. G. C. McV.

1503. Equations of Motion in the New Electrodynamics. Z. Chraplywy. *Comptes Rendus*, 202. *pp.* 396–397, *Feb.* 5, 1936.—A new action function has been introduced by Infeld into the electrodynamic theory recently developed [see Abstract 121 (1935)]. The equation of motion of the electron in the new form of the theory is here derived. J. S. G. T.

1504. Mathematical Theory of a New Relativity. S. M. Sulaiman. *Acad. Sci., Proc., U.P., India*, 5. *pp.* 123–170, *Dec.*, 1935.—In reply to criticisms made against his theory, the author points out that his fundamental assumption is merely that gravitational influence is propagated outwards from a massive body with a finite velocity and he also defends his assumptions with regard to the nature of light and to the cause of the spectral shift in the light from distant nebulæ. He now also claims that relative velocity is meaningless since the observed value depends on the experiment employed to measure the velocity. Further consequences of the hypothesis that gravitation is propagated with a finite velocity are worked out. By postulating that the planets are moving in a resisting medium which is partly due to interstellar matter and partly due to a cloud surrounding the sun, the author shows that his theory can be adjusted to give the small observed changes in the eccentricities of the orbits of the planets. G. C. McV.

See also Abstracts 1525, 1526, 1557.

SOLUTION.

1505. Thermodynamic Calculation of the Solubility of Nitrogen-Hydrogen Mixtures in Water under Pressure. I. R. Kritschewsky and J. S. Kasarnowsky. *Zeits. f. phys. Chem.* 176. *Abt.A.* 1. *pp.* 48–54, 1936.—The fugacity of N_2 in mixtures with H_2 is calculated on the assumption that all the mixtures up to a $N_2 : H_2$ ratio of 1 : 3 possess the properties of an infinitely dilute solution of N_2 in H_2. The equation previously given by the authors [see Abstract 100 (1936)] is then used to calculate the solubilities of each of the gases in water at 25° C. up to 1000 atmospheres pressure from a particular mixture containing 76·42 % of H_2. This mixture is chosen because experimental values have been measured for it by Wiebe and Gaddy [see Abstract 4120 (1935)]. The present calculations are in better agreement with the observations than are those of Wiebe and Gaddy. L. A. W.

1506. Solubilities and Free Energies of Metallic Sulphides. S. F. Ravitz. *J. Chem. Phys.* 40. *pp.* 61–70, *Jan.*, 1936.—The values recommended for the standard free energies of formation, the solubility products, and the solubilities in water are given for the following sulphides: ZnS, PbS, CuS, Tl_2S, CdS at 25° C. and Cu_2S and Ag_2S at 25° C. and 10° C. J. K.

1507. Determination of Bound Water by Ultracentrifuge. J. W. McBain. *Am. Chem. Soc., J.* 48. *pp.* 315–317, *Feb.*, 1936.—Simple formulæ are derived to show the error caused in ultracentrifuge observations by neglecting the solvation of the dissolved material. It is often insignificant, but may amount to hundreds per cent. It is shown how the amounts of bound water may be measured by the ultracentrifuge. AUTHOR.

See also Abstracts 1423, 1770, 1842.

SURFACE TENSION AND COHESION.

1508. Contact Angles from Dimensions of Small Bubbles and Drops. Part I. Spheroidal Segment Method for Acute Angles. G. L. Mack. Part II. Sessile Drop Method for Obtuse Angles. G. L. Mack and Dorothy A. Lee. *J. Phys. Chem.* 40. *pp.* 159–176, *Feb.*, 1936.—Very small liquid drops may be applied to such flat areas as occur in plant materials. In Part I a method is given for the determination of acute angles of contact by measurement of the radii of contact and the volumes of small drops. Equations are developed for evaluating the small effect of gravity on the form of the drop, and the effect of curvature of the solid surface. It is shown experimentally that with decreasing drop size the contact angle of water on apple wax has an increasing value which reaches agreement with the maximum advancing contact angle, as measured by other methods, when the drop diameter is not greater than about 1·2 mm. Distilled water on azobenzene and 0·05 % soap solution on paraffin wax also gave results in agreement with other methods. In Part II it is shown how, by the aid of Bashforth and Adams's tables, obtuse contact angles may be calculated from the surface tension, vertical height, and horizontal radius of sessile drops. By this means unavoidable personal error in judging the tangent to the curved drop surface at the point of contact is eliminated, and, moreover, an average value not unduly influenced by irregularities at a given point on the solid supporting surface is obtained. P. H. B.

1509. Calculation of Surface Tension from Experiment. Parts II and III. A. W. Porter. *Phil. Mag.* 21. *pp.* 703–708, *March*, 1936.—The author gives a graph, conveniently adapted for the calculation of the surface tension from experimental data, giving values of Δ in the equation $\beta^2/r^2 = (h_0/2r) + \Delta$ for all values of $h_0/2r$ from zero to 5. This is based on the Poisson-Rayleigh equation for very narrow tubes and zero angle of contact, Rayleigh's formula for very wide tubes, and Bashforth and Adams's tables for tubes of intermediate diameter. Very near to the critical point h_0 has molecular dimensions and the formulæ do not apply. The author's previous treatment of the problem of meniscus heights for zero contact angle [see Abstract 1355 (1933)] is here revised to include, by means of Bashforth and Adams's tables, very narrow capillaries and exceedingly small drops. A graph connects h/r with Δ_2 an otherwise unknown term, in an expression for β^2/r^2. P. H. B.

1510. Behaviour of Water Held in Fine-Pored Media. B. H. Wilsdon, D. R. G. Bonnell and (Miss) M. E. Nottage. *Faraday Soc., Trans.* 32. *p.* 570, *March*, 1936.—A correction. [See Abstract 4123 (1935).] AUTHORS.

1511. Surface Tension of Calcium Amalgam. L. Convers. *Comptes Rendus*, 202. *pp.* 289–291, *Jan.* 27, 1936.—The surface tension is determined at 20° C. by the drop weight method, the drops forming every 15 to 25 sec. in a chamber at a pressure of 1×10^{-5} mm. previously degassed by heating. The higher Ca concentrations are determined by solution in $N/50$ HCl and titration, while the lower concentrations are obtained by dilution. The results are calculated by Harkins' method. For pure Hg 442 dynes/cm. is found in agreement with previous determinations. The surface tension falls proportionately with concentration to 391 dynes/cm. at 0·00033 gm. per 100 gm. and then rises and attains 403 dynes/cm. at 0·0033 gm. per 100 gm. This is not due to oxidation. The amalgam is prepared both by electrolysis of $CaCl_2$ and by direct combination of Hg and Ca, but the method of preparation does not affect the results obtained. P. H. B.

1512. Water Jets. K. Prosad and B. N. Ghosh. *Indian Journ. Phys.* 10. *pp.* 31–42, *Jan.*, 1936.—In Part I a sonorous water tap is described. The jet of water from this tap has a beaded appearance with an axial core. Photographs of the jet with time exposure of 20 sec. show the steadiness of the jet. Some earlier relations connecting λ, the wavelength of recurrent figures with the velocity of the jet and also the frequency of the note with velocity are verified. There are still some interesting features in the structure of the jet which are not yet clearly understood. In Part II of the paper, from the stationary pattern of ripples formed on a silent jet, when an obstruction is interposed, a convenient method is worked out for the determination of the surface tension of water. The mean value obtained is 71·6 dynes per cm. and is as good as can be expected. AUTHORS.

1513. Stream Potentials and D.C. Surface Conductivities in Small Capillaries. H. L. White, Betty Monaghan and F. Urban. *J. Phys. Chem.* 40. *pp.* 207–214, *Feb.*, 1936.—The stream potential, E/P, of glass capillaries falls off with decreasing capillary diameter. This effect is due largely to the increased specific conductivity in the smaller capillaries, due to surface conductivity. While a retarding effect due to electro-osmosis is no doubt present, the data do not permit its evaluation. The κR effect, as applied by Komagata to stream potentials, is negligible except with pores of ultramicroscopic size. The value of E/P with most capillaries falls with time; this is not due to an increase in conductivity but presumably to a decrease in ζ. The normal specific surface conductivity, measured with d.c. of 1×10^{-4} *M* KCl at a pyrex surface is about $1 \cdot 5 \times 10^{-9}$ mho per cm.^{2} and of 5×10^{-4} *M* KCl about $1 \cdot 7 \times 10^{-9}$ mho per cm.^{2} Variations in ζ in a given capillary, as shown by variations in E/P, are also reflected in variations in specific surface conductivity. AUTHOR.

VACUA HIGH.

See Abstract 1415.

VISCOSITY, FRICTION AND LUBRICATION.

1514. Viscosity Formula for Binary Mixtures. T. Ishikawa and T. Baba. *Chem. Soc., Japan, Bull.* 11. *pp.* 8–18, *Jan.,* 1936. *In English.*—In this series of papers [see also Abstract 3784 (1935)] the authors develop the Ishikawa formula for the viscosity of binary mixtures based on the fundamental hypothesis that the associations of both components are invariant throughout the concentration when no chemical change occurs during admixture. H. H. Ho.

1515. Viscosities of Deuterium-Hydrogen Mixtures. A. B. van Cleave and O. Maass. *Canad. J. of Research,* 13. *Sect. B. pp.* 384–389, *Dec.,* 1935.—An investigation is carried out on the viscosities of D_2-H_2 mixtures at 22° C. D_2 prepared from a 99·5% sample of D_2O was used. The results show that, within experimental error, the diameters of the D_2, HD and H_2 molecules are identical. Variations of the viscosity of some of the mixtures with the temperature are measured at −78·5° and −183·4° C. It is shown that Jeans' temperature-viscosity relation holds approximately for the mixtures. A comparison is made of the various equations that have been suggested as expressing the relation between the viscosity of a gaseous mixture and the viscosities of its components. AUTHORS.

1516. Viscosities of Liquid Mixtures. K. E. Spells. *Faraday Soc., Trans.* 32. *pp.* 530–540, *March,* 1936.—Accurate measurements of the viscosities of solutions of four alcohols in benzene are made. In an attempt to correlate viscosity with the dielectric constant, the results obtained for the viscosities of the solutions of two isoamyl alcohols in benzene are examined for anomalies corresponding to those obtained in the case of the dielectric constants. The curves of viscosity plotted against concentration do not exhibit any peculiarities, but, before reaching a conclusion, a new method, suggested here, of investigating the problem must be tried. An equation with one arbitrary constant is deduced to give the viscosity of a binary liquid mixture in terms of its density. This equation is tested against the measurements given here, and also against results obtained by other workers. AUTHOR.

1517. Simultaneous Measurement of Viscosity and Electrical Conductivity of Fused Silicates at Temperatures up to 1400°. M. P. Volarovich and D. M. Tolstoi. *Soc. Glass Technol., J.* 20. *pp.* 54–60, *Feb.,* 1936.—The viscosities and electrical conductivities of a mixed alkali-lime-silica glass, two slags, two enamels and a natural lava, are measured between 780° and 1400°. Discontinuities in the viscosity and conductivity curves for the two slags are due to crystallisation; for the glass smooth curves are obtained in each case and for the natural lava curves of an intermediate type. For the glass, the relation of $\eta \cdot K^{1 \cdot 4} = 1 \cdot 65$ holds for the range 700–1000° and similar relationships are found for the two slags. AUTHORS.

1518. Influence of Electric Fields on Viscosity of Fluids. P. T. Sokolov and S. L. Sosinskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 3. *pp.* 135–138, 1935. *In German.*—Seven organic fluids are used, namely acetone, ethyl iodide, methyl alcohol, ether, chloroform, hexane and benzol and an Ostwald type of viscometer, fully described. The effects of d.c. and a.c. fields of different voltages are determined and the results tabulated and plotted. [See Abstract 1921 (1935).] J. K.

✱1519. Wall Correction for Falling Sphere Viscometer. E. I. Fulmer and J. C. Williams. *J. Phys. Chem.* 40. *pp.* 143–149, *Jan.*, 1936.—An equation is derived by means of which the wall correction for the falling sphere viscometer can be made for values of r/R up to about 0·500. AUTHORS.

✱1520. Absolute Viscosity by the Falling Sphere Method. L. R. Bacon. *Frank. Inst., J.* 221. *pp.* 251–273, *Feb.*, 1936.—The Stokes formula for calculation of viscosity of a fluid fails badly when applied over the range 10 to 10,000 poises under ordinary conditions. Many viscosity data based on this relation which is valid only for a medium infinite in extent appear to be seriously in error. Several published corrections also fail but the Faxen relation, based on strict hydrodynamic theory, gives results in good agreement with values obtained by the improved capillary tube technique. Viscosity measurements on glycerol and "Viscous Oil" by the falling sphere method agree with values reported by Armour & Co., and by the Bureau of Standards over the range 7 to 3660 poises with maximum differences of less than 1 %. Considerable practical as well as scientific interest attaches to the findings above since the requirements of apparatus and technique for measurement of absolute viscosities over a wide range with high accuracy are simple, inexpensive and generally available. The method is especially well suited for the range 10 poises and upwards and has been used in commercial research. AUTHOR.

1521. Influence of Alkalinity of Glasses on Viscosity of Dilute Collodion. J. Grévy. *Comptes Rendus,* 202. *pp.* 480–482, *Feb.* 10, 1936.—Only 1/15th as much alkali is extracted from pyrex as from ordinary glass on heating water for a few hours at 90° C. approx. in a flask. A synthetic collodion, containing 0·3 gm. of type CP_2 cotton powder, dissolved in 40 gm. ether and 60 gm. absolute alcohol, both freshly distilled, showed after 10 months in a pyrex flask a drop of only 15 % from the original viscosity of 0·135, and in an ordinary glass flask of the same size, a drop of about two-thirds. If the surface/volume ratio is increased by adding broken glass the viscosity becomes hardly measurable. Previous to test the flasks were treated with a mixture of chromic and sulphuric acids, then washed with water. If this treatment is omitted with ordinary glass the viscosity drops more rapidly. Addition of 0·01 gm. potash or sodium carbonate to the collodion caused a drop almost to zero after 6 hr. and 24 hr. respectively. [See Abstract 2348 (1935).] D. R. H.

1522. Vibrations with Sliding Friction. H. Bock. *Zeits. f. Instrumentenk.* 56. *pp.* 71–74, *Feb.*, 1936.—Expressions are obtained for the period of oscillation for the cases where (1) the coefficient of friction is independent of the velocity, and (2) steady friction is greater than moving friction. Numerical examples are considered. Finally the period is found for oscillations produced with fluid friction. R. S. R.

See also Abstracts 1465, 1563, 1749.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1523. Effect of Rotating Secondary Mirror of Coelostat. T. W. Wormell.** *Roy. Astron. Soc., M.N.* 96. *pp.* 159–165, *Jan.*, 1936.—It is generally convenient to introduce a stationary secondary plane mirror to direct the reflected beam into the telescope. The author examines the problem of moving the image slowly by rotating this secondary mirror. The case where the beam after reflection travels horizontally and due north is given in detail, with the effects (horizontal and vertical displacement and orientation) of rotation about vertical and horizontal axes. In the case of rotation about a vertical axis the image moves in a direction inclined both to the horizontal and to the image of an east-west line with an angular velocity always less than twice that of rotation of the secondary mirror; both effects vary with the declination. T. L. M.

***1524. 200-in. Reflector of the Astrophysical Observatory, California Institute of Technology. G. E. Hale.** *Nature*, 137. *pp.* 221–228, *Feb.* 8, 1936. *Supplement.*—The offer of a 200-in. disc was accepted, rather than of 300-in. The new observatory is to be located on Palomar Mt. (lat. 33° 21′ 20″ N; alt. 5600 ft.), where the average seeing is better than on Mt. Wilson—already affected by the Los Angeles lights; and this last would be more serious with the new *f*/3·3 ratio than the Hooker *f*/5. Plate glass was used for the Hooker 200-in.; fused silica was tried for the new accessory telescopes, but pyrex with its small variant with temperatures was used for the 200-in., which is now ready for shipping by rail to Pasadena. In the mounting there is a cartridge-shaped house at the principal focus, which with its short 55 ft. focus will give bright images for the faintest objects with relatively short exposure. A very short spectrograph objective (*f*/0·59) by Rayton has been put on the Hooker, and Humason has measured with it the extraordinarily high apparent velocities of the exterior galaxies; a second spectrograph objective (*f*/0·36) from the British Scientific Research Association will be even faster than the Rayton lens. Its speed and efficiency is only determined by the blackness of the night sky. The 200-in. reflector will be aluminium coated. A. S. D. M.

See also Abstract 1480.

COSMOGONY.

1525. Prismatic Deviation as a Function of Cosmical Orientation. F. L. Whipple, T. E. Sterne and D. Norman. *Nat. Acad. Sci., Proc.* 22. *pp.* 15–19, *Jan.*, 1936.—Measurements of the total deviation of light in a rigidly constructed 2-prism spectrograph were made to detect any possible changes produced by azimuthal rotation of the instrument in its optical plane at various sidereal times. The arrangement of the apparatus is clearly described. A grating with clear spaces of 0·5 mm. at intervals at 1 mm. gave interrupted lines; by moving the grating a second exposure with the position of the instrument altered filled in the gaps. The reduction of the results is fully described. The refractive index was found constant within an accuracy of about 5×10^{-8}. No correlation with sidereal time was found. T. L. M.

1526. Constant of Gravitation and the Number of Particles in the Universe. H. Ertel. *Phys. Zeits.* 37. *pp.* 138–139, *Feb.* 15, 1936.—The author's formula for the gravitation constant in terms of the charge and mass of the electron, the fine-structure constant and the number, N, of protons in the universe does not give the correct value if Eddington's value for N is adopted. To obtain the observed value of the gravitation constant N must be equal to 128×2^{256}. G. C. McV.

See also Abstracts 1500, 1546.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1527. Periodic and Asymptotic Solutions of the Restricted Problem of Three Bodies. K. Popoff. *Bull. Astronomique,* 9. 3. *pp.* 177–198, *and* 9. 4. *pp.* 199–226, 1934.—A discussion of the existence and classification of the solutions of this problem is given with special emphasis on the justification of the numerical methods employed by Strömgren and the Copenhagen school. [See following Abstract.]

G. C. McV.

1528. Periodic and Asymptotic Solutions in the Restricted Problem of Three Bodies. A. Wintner. *Bull. Astronomique,* 9. 4. *pp.* 251–253, 1934.—The author replies to criticisms of his work made by K. Popoff [see preceding Abstract]. In particular he points out that Poincaré's principle of exchange of stability in the case of ramification of orbits is not universally true since particular cases can be found when it is false. G. C. McV.

NEBULÆ.

1529. Visual Spectra of Gaseous Nebulæ. R. H. Stoy. *Lick Observat., Bull. No.* 480. *pp.* 179–184, 1935.—The increase of speed in colour-sensitive plates has recently made it possible to study the visible and infra-red region of the nebular spectrum, and these are important since many of the forbidden transitions lie in this region. The instrument is described. The nebula was held stationary on the centre of the slit so that localisation of emission in it might be traced, and the slit was longer than the nebular diameter, so as to bring in sky lines. The chief results are the first identification of Cl in a nebula, and the identifications of emission lines in Novæ with certain forbidden lines in the nebula.

A. S. D. M.

1530. Photometric Observations of Some of Barnard's Dark Nebulæ. O. Struve and C. T. Elvey. *Astrophys. J.* 83. *pp.* 162–172, *March,* 1936.—Observations of several dark nebulæ show that their surface brightnesses differ by a few hundredths of a magnitude from that of the sky background. The computed Δm which should be added (because of scattering of general starlight in the dark nebula) to the observed sky brightness is about 0·15 mag. The discrepancy may be due to a lower albedo of the particles than was assumed in the computation, or to scattering in interstellar space. The existence of scattering of general starlight by interstellar clouds is demonstrated by a series of observations of B15, the core of which is appreciably darker than the rim, although the latter is about as opaque as the former. AUTHORS.

See also Abstract 1547.

PLANETS.

1531. Occultations and Eclipses by Planets. F. Link. *Bull. Astronomique,* 9. 4. *pp.* 227–250, 1934.—Planetary atmospheres are evidenced by (1) the deviation, (2) the dimming of rays traversing it, and (3) through selective absorption of certain wave-lengths. No. 2 is the method used, and it covers the occultations of stars and satellites and their eclipses. A simple exponential value of the planetary atmosphere taken is obtained, and a ray refracted through it falls under 3 categories: (1) where it goes to infinity (as with the earth); (2) where it never quits the atmosphere but osculates the boundary of a definite radius, greater than the planet's real radius, which boundary in consequence is opaque to all beneath it (as in the case of Jupiter); or (3) is refracted back to the planet's surface at some lower, indeterminate level. The author gives a general theory of occultations and eclipses with numerical applications. A. S. D. M.

1532. Spectroscopic Study of Planetary Atmospheres. J. Gauzit. *Bull. Astronomique,* 9. 5. *pp.* 293–304, 1934.—The author gives a detailed history of planetary spectroscopy, and sums up the results as: Mercury has no perceptible atmosphere; Venus has an extensive one, chiefly of carbonic gas; the atmosphere of Mars is much less dense than the earth's, and if there is oxygen in it, its quantity must be exceedingly small. Wildt suggests that the oxygen is wholly ionised, just as it is in similar conditions of density in the earth's upper atmosphere. The four great planets have extensive atmospheres of hydrogen and methane, though hydrogen is not itself evident. On Jupiter there is ammonia, but partly solidified, and on Saturn the ammonia is almost wholly solid, and on Uranus and Neptune completely so, thus allowing the sun's rays to penetrate deeply into the atmosphere of hydrogen and methane. A. S. D. M.

1533. Radiation from Planet Mercury. E. Pettit and S. B. Nicholson. *Mt. Wilson Observat. Contrib. No.* 533. *Astrophys. J.* 83. *pp.* 84–102, *March,* 1936.—Mercury radiation measurements were made in 1923–25 with the vacuum thermocouple, at the Newtonian focus of the 100-in., when near the meridian, by transmission over the whole disc through cover-glass, water-cell and fluorite screen, and were reduced as were those from the moon; the reflected light being separated from that of planetary surface by a water-cell corrected for transmission losses. Both heat and reflected light resemble the moon's, mercury being not quite so rough, but both observed heat curves are lower than the theoretical. The mercury water-cell absorption of reflected light is near 0·06 mag. or equivalent to a star of type gG8. At full phase, the subsolar temperature is near the mean, and a diagram shows that the planetary heat value of the whole disc at unit distance and zero phase is $T = 600^\circ$ K., but from the solar constant at the subsolar point is $T = 617^\circ$ K. Taking the mean (610° K.), the temperatures at perihelion and aphelion are 685° and 500° K. Mercury's albedo is 0·72, that of the moon being 0·93. A. S. D. M.

1534. Photometric Comparison of Moon and Sun. Photoelectric Albedo of the Moon. G. Rougier. *Comptes Rendus,* 202. *pp.* 463–465, *Feb.* 10, 1936.—A calculation of the sun's and moon's albedos with the same photoelectric cell. Photometric observations of the sun were made at Sanary between 3–11 August, 1935, but unfavourable conditions yielded only 8 determinations whose mean value when reduced to the scale of unit distance gave a preliminary value for the sun's magnitude as reduced by the instrument, which later was made definitive as

$m = -14^{\mathrm{m}}.872 - 2^{\mathrm{m}}.468 = -17^{\mathrm{m}}.34$. The author calculates Bond's albedo (the only one from an astronomical point of view). For the moon the photoelectric albedo should differ little from the photographic, being given by the spectral region sensitive for a potassium cell, and has a value, $A_k = 1 \cdot 9055 \times 10^{-1} \times 0 \cdot 5845 \times 2 \cdot 0487^{-1} = 0 \cdot 0544$; Russell's value for the visual albedo is $A_v = 0 \cdot 073$. The difference of colour index for sun and moon deduced from the visual and protoelectric albedos is given by $\Delta\,\mathrm{CI} = \log_{10} (A_v/A_k) \times (0 \cdot 4)^{-1} = +\,0^{\mathrm{m}}.32$. The sun's colour index adopted being $+\,0^{\mathrm{m}}.79$, that of the moon should be: $\mathrm{CI} = +\,1^{\mathrm{m}}.11$. But taking the moon's CI from a particular phase, say dichotomy, we find for the moon $\mathrm{CI} = +\,1^{\mathrm{m}}.24$; the former value is the more sure being the ensemble of all observations of the moon. A. S. D. M.

1535. Selenology. F. Leitich. *Gerlands Beitr. z. Geophys.* 46. 3. *pp.* 301–316, 1936.—The author considers that observation shows the visible surface of the moon to be formed of strata of considerable thickness, beneath which lie the lunar rocks and possibly an old sedimentary layer. These strata, extending to several km., consist principally of light chlorides and the walled plains are produced by the elevation of these layers by the pressure of gases released in the volcanic interior. On this view the maria do not represent the (? basaltic) material of the moon's interior. Observations of slopes, etc., are well accounted for. Much of the paper is devoted to a consideration of the views of I. Ruud and E. Haarmann, both of whom trace lunar orogenesis to pressure or intrusion from either the moon's core or a Sima layer. T. L. M.

STARS.

1536. Internal Movements of Star Streams. Renée Canavaggia and Marie-Louise Fribourg. *Bull. Astronomique*, 9, 5. *pp.* 259–292, 1934.—The differential rotation of our galaxy, now generally accepted as a fact, will necessarily bring about a rapid dispersal of star clusters and star streams, unless the component stars are kept together by mutual attraction. Bok has shown that the stars will keep together and will show movements of internal rotation if the density of the group exceeds a certain critical value; and it appears that this value equals the existing stellar density in the sun's neighbourhood. Stars of the three streams, Taurus, Ursa major, and Scorpio-Centaurus are examined and their speed and direction in the galaxy determined. They do not show the differential galactic rotation of Oort. The Taurus and Ursa major groups appear to be rotating each round its own centre, and the Scorpio-Centaurus group is dispersing into space. All the movements used in the research are catalogued and also represented in graphs. M. A. E.

1537. Radial Velocities and Star Streaming. W. M. Smart. *Roy. Astron. Soc., M.N.* 96. *pp.* 165–171, *Jan.*, 1936.—The radial velocities of 3679 stars (arranged in galactic zones) are used to test the two-streams theory. The mean radial speed of the stars in a drift is found to be almost exactly that deduced from Eddington's analysis of the Boss proper motions. The stars are equally divided between the two drifts. A small progression, with galactic latitude, of the mean radial speed of the stars in a drift is found. AUTHOR.

1538. Derivation of Frequency Function of Space Velocities of the Stars from Observed Radial Velocities. V. Ambarzumian. *Roy. Astron. Soc., M.N.* 96. *pp.* 172–179, *Jan.*, 1936.—The frequency function of the space-velocities of stars of a given type is derived from the observed distribution of radial velocities without making any assumption as to the form of the frequency function but assuming that this function is practically the same for all elementary volumes of space in our neighbourhood. The solution of the problem depends on an integral equation in which the observed frequency function of the radial velocities, for different parts of the sky, is the known function. The two-dimensional and three-dimensional cases are treated separately and the former case, when applied to the B-type stars in the galactic belt, gives good agreement with the results of direct counts of the known space velocities. G. C. McV.

1539. Variable Spectrum of ζ Tauri. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 96. *pp.* 230–235, *Jan.*, 1936.—A series of 186 photographs, 1923 Jan. to 1935 March, confirm the variability of the spectrum. The points studied are: intensity of central absorption of Hβ, combined and relative intensity of bright components of Hβ, and intensity of some of the ionised lines. All the absorption lines show somewhat similar changes, apart from minor fluctuations due to the use of eye estimates; but wedge micrometer comparisons confirm the general trend satisfactorily; the variation of the bright components is inverse to that of the absorption lines. The period is not long enough to show the period of variation if any, but a shorter periodicity of 430 days may be superimposed. The published evidence for the relative intensity of the bright components is conveniently summarised. T. L. M.

1540. Darkening at the Limb and Colour Index of an Eclipsing Variable (U Cephei). H. O. Rosenberg. *Astrophys. J.* 83. *pp.* 67–83, *March*, 1936.—A method is described whereby it is possible to derive colour indices for two effective wave-lengths from simultaneous exposures on one plate, in the focal plane of a Newtonian reflector. This method was used for the eclipsing variable U Cephei at λ 4015 and λ 6165. The total change in colour index between the phase of constant light and that of primary minimum amounts to 1·51 mag. The greater part of this change is caused by the difference in spectral type between the bright star (Ao) and the fainter component (G6). A study of the individual light-curves obtained in different wave-lengths reveals an effect of darkening at the limb, which increases with decreasing wave-length and which is comparable to the darkening observed in the sun. However, the total range in the amount of darkening between λ 4015 and λ 6165 is smaller for the A0 star than for the sun. AUTHOR.

1541. Stationary Lines in the Spectrum of the Binary Star Boss 6142. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 536. *Astrophys. J.* 83. *pp.* 126–128, *March*, 1936.—The spectroscopic binary Boss 6142 has a velocity range of 235 km./sec. in a period of 13·4 days, but the detached lines D1, 2, and $\lambda\lambda$ 5780, 6284 (and probably λ 5797) remain stationary. AUTHOR.

1542. Spectrum of Arcturus. S. G. Hacker. *Astrophys. J.* 83. *pp.* 140–161, *March*, 1936.—A summary of the atomic and molecular spectra of Arcturus type Ko, with surface temperature 4300° K. (thermocouple) or 3840° K (spectroscopic), parallax, $0''{\cdot}080$ (trigonometric), diameter, $0''{\cdot}020$ (interferometer), surface gravity $1/80\odot$. The spectrograms are low dispersion (exposure, $0^h\ 42^m$) for region $\lambda\lambda$ 4119 – 6743, and high dispersion (exposure, $6^h\ 16^m$) for regions $\lambda\lambda$ 4245–4520 and $\lambda\lambda$ 4525–4975; measured on a Hilger comparator; the weighted mean of 1099 lines gives radial velocity of $-\ 6{\cdot}17 \pm 0{\cdot}20$ km./sec. A detailed discussion is made of the elements definitely present or absent, and those for which evidence is doubtful or wanting. Of about 350 lines unblended but not identified, about 100 coincide with sunspot bands. Throughout the star's spectrum the relative intensities of the sunspot spectra are similar in the arc, but stronger in the enhanced lines. About 3,000 lines are identified, and about 30 unblended lines of moderate strength are unidentified. A. S. D. M.

1543. Spectrum of Z Centauri. Cecilia P. Gaposchkin. *Astrophys. J.* 83. *pp.* 173–176, *March*, 1936.—The spectrum of the super-Nova Z Centauri can be interpreted as that of a Nova in the " 4640 " stage with abnormally wide bright lines. Since Nova Aquilae No. 4 appears not to be a Nova at all, this observation removes from the lists all the supposed Novæ that showed only absorption spectra after maximum. AUTHOR.

1544. Pressure in the Interior of a Star. E. A. Milne. *Roy. Astron. Soc., M.N.* 96. *pp.* 179–184, *Jan.*, 1936.—Eddington's theorem, *viz.* that the minimum value of the central pressure in a star of mass M and radius R is $3GM^2/8\pi R^4$, provided that the density does not decrease inwards, is shown to hold also under the less stringent condition that the density inside radius r is always less than the mean density inside radius r. Thus, subject to this condition, outward increases of the density are permissible. The theorem also holds good for incompressible matter. Improved inequalities are also found for the gravitational potential energy and mean value of gravity in a star. G. C. McV.

1545. Stellar Configurations with Core of High Energy Density. A. B. Severny. *Roy. Astron. Soc., M.N.* 96. *pp.* 219–230, *Jan.*, 1936.—The model contemplated consists of an envelope behaving as a perfect gas, surrounding a core containing matter at a high density of energy. The equation of state of such matter is investigated. It is further assumed that there are different integrals of pressure in the two layers. The problem of equilibrium is then examined and several cases are considered. Some general suggestions for a comparison with observation are given. T. L. M.

1546. Diffusion of Stellar Light. Wang Shih-Ky. *Comptes Rendus*, 202. *pp.* 284–286, *Jan.* 27, 1936.—The intensity due to stars is estimated to decrease with distance from the galactic plane according to an exponential formula, the constant of which is determined. The intensity produced by an infinite diffusing medium is calculated as before [see Abstract 518 (1936)] ; the result for the galactic poles is of order 2/3 of the stellar intensity. T. L. M.

1547. Summary of Investigations of Variable Stars. H. Shapley. *Nat. Acad. Sci., Proc.* 22. *pp.* 8–14, *Jan.*, 1936.—Of 1000 small Magellanic cloud variables, stars below 16·5 median magnitude are incompletely recorded, and their distance modulus is fainter than the 17th mag., and cluster type Cepheids are not included. 2·5 % in the smaller cloud and 1·5 % in the larger up to magnitude 16·8 are variable stars, probably Cepheids; in the smaller there are 200 Cepheids brighter than — 2·0 photographic magnitude, which may give a period-luminosity curve. A difference in the slopes of the P–L curves of the two clouds remains unexplained. For the smaller, 20–40 day-period Cepheids give amplitudes 30 % greater than those of shorter or longer periods, agreeing with Milky Way data. Milky Way Fields 167, 168, 169, 184, 193 and 239 are investigated. The variables in high galactic latitudes seem to give a spherical form—as with the Andromeda nebula—to the Milky Way. A. S. D. M.

1548. Suspected Variation in the Light of β Canis Minoris. W. M. Smart. *Roy. Astron. Soc., M.N.* 96. *pp.* 258–262, *Jan.*, 1936.—The Harvard photoelectric observations of the difference in magnitude between Procyon and β Canis Minoris are first corrected for atmospherical extinction. The resulting light-curve is of the Cepheid type, with a period of $0^{d}\cdot 09$; the difference between maximum and minimum is $0^{m}\cdot 02$. It is shown that the observational data are in good accordance with the period-luminosity law, and it is concluded that β Canis Minoris is a short-period Cepheid or cluster-type variable. AUTHOR.

1549. Nebular Spectrum of Nova Herculis. A. Beer. *Roy. Astron. Soc., M.N.* 96. *pp.* 236–258, *Jan.*, 1936.—The nebular spectrum of Nova Herculis between 1935 May and December is analysed. The origin of about 100 bright and mostly blended bands in the region λ 3120–λ 6580 can be attributed to the following 30 atoms: H, He I, He II, C II, C III, C IV, N II, N III, N IV, N V, [N II], O II, O III, O IV, O V?, [O I], [O II]?, [O III], [F III]?, [Ne III], [Ne IV]?, [Ne V]?, Al II?, Si III, Si IV, S II, [S II]?, [A IV], [A V], [Ca V]?. The structure of the main bright bands is studied in detail. AUTHOR.

1550. Spectrum of Nova Herculis. H. Camichel. *Comptes Rendus*, 202. *pp.* 286–288, *Jan.* 27, 1936.—Two series of spectra are obtained with a 3-prism slit spectrograph on the great Meudon telescope; region covered Hα to Hβ. In March, 1935, there was still a continuous spectrum with some absorption lines, and numerous emission lines with two maxima symmetrically placed about the normal position. Measures, identifications and velocities are given. The velocity varied for each element. From Sept. to Nov. the nebular phase is found, with the two green lines, disappearance of most of those measured in March, inequality of the two maxima, and reduced velocities, greatest for N in both periods. Considerations on the significance of these observations are added. From the velocities and the measured separation of the two components the distance (2560 L.Y.) and absolute magnitude are estimated. T. L. M.

1551. Light Curve of Nova Herculis 1934. H. Grouiller. *Comptes Rendus*, 202. *pp.* 465–467, *Feb.* 10, 1936.—From Dec. 14, 1934—the day after discovery—until Feb. 1, 1935, no night of observation was missed by the observers of the French Variable Star Association. The method of observation was Pickering's, and a weighted curve of light is given for each Julian day between Dec. 14, 1934, and Sept. 30, 1935. The light curve is singular for a Nova; when discovered it was near $3^{m}.5$, and took 8 days to reach its highest magnitude, $1^{m}.5$ (possibly $1^{m}.2$) on Dec. 22. Then it made a brisk descent to $2^{m}.5$ and quivered round this magnitude until Jan. 15, 1935, when it made a steep descent, then recovered to $2^{m}.5$, but again quivered down, at first slightly, then very steeply to a minimum of $13^{m}.0$ on April 30; thereafter it rose slowly to $6^{m}.5$ about July 28, and has remained near that value until Sept. 30. A. S. D. M.

1552. New Elements for the Spectroscopic Binary Boss 6142. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 535. *Astrophys. J.* 83. *pp.* 121–125, *March*, 1936.—A new set of orbital elements is derived for the primary of the spectroscopic binary Boss 6142, based upon data for the earliest Mount Wilson (1911–12) velocities, the recent Mount Wilson and Victoria velocities (1924–34), and the numerous Ottawa observations (1915–16). The only significant change is a decrease in the period from

$13^{\mathrm{d}}.435$ to $13^{\mathrm{d}}.4187$. All available data give 144 km./sec. as the semi-amplitude of velocity variation for the secondary star, as compared with Young's tentative value of 167 km./sec. The secondary's spectrum tends to make the measured velocities too close to the γ-value when the stronger lines of the primary coalesce with the weaker lines of the secondary. The derived minimum masses of primary and secondary are $13 \cdot 5 \odot$ and $11 \cdot 0 \odot$, respectively; the minimum distances from the centre of mass, 21,572,000 and 26,438,000 km. Young's mean value for the velocity from the detached lines of Ca is $-24 \cdot 4$ km./sec.; that from recent Victoria and Mount Wilson spectrograms, $-18 \cdot 0$ km./sec.; and Merrill's mean velocity from the detached Na lines, $-19 \cdot 5$ km./sec. The agreement of the recent Ca and Na velocities may indicate a systematic difference between the measures made at Ottawa and at Victoria and Mount Wilson.

AUTHOR.

See also Abstracts 1529, 1558, 1613.

SUN.

1553. Turbulence in Solar Atmosphere. M. Kurihara. *Kyoto Coll. Sci., Mem.* 18. *pp.* 295–308, *Nov.,* 1935. *In German.*—The investigation assumes that the element of turbulence alters adiabatically during its motion. The expression of Richardson for the transformation of available heat into kinetic energy in vortices in dry air is shown to be applicable to the sun. It is assumed that the interchange of matter varies as a power of the energy of turbulence; the method of C. G. Rossby is followed and his equation solved. The levels at which turbulence arises and disappears are examined numerically. A turbulent zone is found in the sun's atmosphere, about 7000 km. deep, with its upper surface in the chromosphere. The mean velocity of turbulent motion would be of the order of 10 km./sec. T. L. M.

1554. Observations of Solar Prominences at the Pic du Midi in 1935. B. Lyot. *Comptes Rendus,* 202. *pp.* 392–394, *Feb.* 5, 1936.—An improved coronograph was used with four coloured filters. The H_α radiation is strongly absorbed by the dense parts of a prominence whilst the radiation D_3 changes in intensity proportionally to the thickness of the vapour. The continuous spectrum is shown to be emitted by all parts of the prominence and not by clusters of particles scattered throughout the prominence. The polarisation of the light in emission lines is found to be as previously observed. The light in the continuous spectrum is observed to be polarised radially like that of the corona. Thus the continuous spectra of prominences and corona must be due to the same cause. A kinematograph film of a prominence has been taken which, when speeded up, shows the development of the prominence and the motions of clouds of gas within it. G. C. McV.

1555. Sunspot Period. E. Sluckij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences,* 4. 1–2. *pp.* 37–40, 1935. *In English.*—From Brunner's list of sunspot maxima and minima for the years 1610 to 1928 a period for the sunspot cycle may be deduced of $11 \cdot 14435$ years. We can continue the research backward in time by examinining the historical records of remarkable auroræ from A.D. 1605 to 501 B.C., collected by Fritz. These, as is known, coincide with sunspot maxima, and the period deduced from them is $11 \cdot 10266$ years. It appears, therefore, although the evidence is not quite conclusive, that the period does not sensibly alter. M. A. E.

1556. Ultra-Violet Intensities at Different Latitudes and Altitudes. F. Fuchs. *Gerlands Beitr. z. Geophys.* 46. 3. *pp.* 257–260, 1936.—Over a region in Central Europe the u.v. intensity of the light from the sun and sky is measured with a dosimeter. The results are divided into five divisions of sea, lake, land, medium and high mountains and three districts of decreasing latitude. It is shown that for like places, the decrease in latitude increases the u.v. energy, while over the sea, over the lake and on a high mountain the intensity is greatest. The maximum occurs about 10 a.m. but varies somewhat from place to place. H. M. B.

1557. Red Shift of Fe Lines at the Sun's Edge. J. Evershed. *Roy. Astron. Soc., M.N.* 96. *pp.* 152–159, *Jan.*, 1936.—Numerous measures of the author's prism spectra and of Kodaikanal grating spectra confirm the suggestion by St. John that Fe lines show a limb effect additional to the Einstein shift. Limb shifts are also deduced for over 100 Fe lines from published data; for lines also measured by the author there is good agreement. The limb shift is underestimated because of scattered light, measurement near but not at the limb, and local currents which render means of at least 20 spectra necessary. It is suggested that the shift is equivalent to doubling the Einstein effect. No theoretical explanation is put forward; but the effect applies equally to certain prominence lines.
T. L. M.

1558. Fluorescence Phenomena and Central Intensities in Fraunhofer Lines. A. Pannekoek. *Roy. Astron. Soc., M.N.* 95. *pp.* 725–732, *Oct.*, 1935. *Supplement.*—The observed central intensities of H lines are accounted for by Woolley [see Abstract 3190 (1934)] as fluorescence phenomena, especially when produced by cyclical processes involving ionisation. The author discusses the processes involved, deriving expressions for the number of transitions and ratio of the number of emissions and absorptions. The dilution factor is discussed in some detail. The main conclusion is that the fluorescence light has the character, by origin and in profile, of a bright emission line, thus dividing the relatively broad-bottomed absorption line centrally. For H it will be broadened by Stark effect and spread over the broadened absorption line; thus it does not produce the narrow reversals actually observed. For other elements the fluorescence emission line will be narrower, depending on the *s* function which decreases with increasing atomic weight. These lines cannot usually be distinguished but may explain the duplicity suspected, without known physical reason, by Rowland in several strong lines of Fe, Sr^+, Cr, Ca.
T. L. M.

1559. Fraunhofer Spectrum in the Neighbourhood of 96,000 Å. A. Adel, V. M. Slipher and O. Fouts. *Phys. Rev.* 49. *pp.* 288–290, *Feb.* 15, 1936.—The absorption of solar radiation by the atmospheres of the sun and the earth is examined with high resolving power over the spectral region from 70,000 to 110,000 Å. This paper is concerned with a discussion of the spectrum in the vicinity of 96,000 Å. The strongest rotation-vibration band of O_3 occupies this region and is separated into lines. The structure of the molecule is discussed in the light of these new data. AUTHORS.

See also Abstracts 1534, 1542, 1574, 1623, 1891, 1892.

GEOPHYSICS.

HYDROSPHERE, PHYSICS OF THE.

1560. Change of Water Level in an Enclosed Sea due to a Temporary Wind. K. Hidaka. *Geophys. Mag., Tokyo,* 9. *pp.* 279–284, *Dec.,* 1935. *In English.*—The first of the numerical results for the extraordinary high water caused in Osaka Bay by the Muroto typhoon on 21st Sept., 1934, are given. The full results are to be given later. The theory has been given already [see Abstract 543 (1934)]. It is found that the seiches with a period of about one hour are rather predominant with a rather large damping factor. Since the oscillation is binodal and the depth is less in the northern part the coefficient of viscosity appears to be very large and the motion of the water is of great turbulency. R. S. R.

1561. Deep Circulation in the Expanse of the Atlantic Ocean. G. Wüst. *Naturwiss.* 24. *pp.* 133–141, *Feb.* 28, 1936.—An outline is given first of the two regions in this ocean described as the troposphere and stratosphere in which the former has a strong vertical temperature gradient, is rich in salt, and has an active circulation, while the latter is colder, has less salt, and a very gradual circulation. The boundary of the two is not well defined but the troposphere is roughly confined to the upper 500 *m.* between 45° S and 55° N. A review is undertaken of the new tracks for salt content and temperature distribution on the basis of numerous charts and it is sought to obtain the extension and mixing of stratospheric water masses over the ocean expanse. Charts illustrate the salt content, temperature, oxygen content and fraction for the sub-Antarctic component and the N. Atlantic deep water component. Finally a chart is built up to show the meridional extension of essentially stratospheric masses in the Atlantic. R. S. R.

1562. Trent Bore. H. H. Champion and R. H. Corkan. *Roy. Soc., Proc.* 154A. *pp.* 158–181, *March* 2, 1936.—The paper is based on tidal observations in the River Trent during the years 1928–31. The observations which were partly visual and partly automatic are either tabulated or reproduced in the form of diagrams. The latter include observed typical tide curves at a number of places on the Trent, and a series of automatic records, taken at Flixborough, of the eagre and the rise that immediately follows it. The observations are reduced, and tables are constructed of non-harmonic tidal differences, on occasions of spring and neap tides, at a number of stations on the Trent within the region where the eagre is observed. These tables together with information from other sources are used, to discuss the inward propagation of the tides in the Trent, and to deduce the changes in form that an ingoing wave apparently undergoes. AUTHORS.

See also Abstract 1623.

LAND, PHYSICS OF THE.

1563. Motion of Viscous Fluid Under a Surface Load. Part II. N. A. Haskell. *Physics,* 7. *pp.* 56–61, *Feb.,* 1936.—Following up previous work [see Abstract 4164 (1935)] on the subsidence of a circular load on the surface of a highly viscous fluid, the same problem is treated for the case of a load in the form of an infinitely long strip with parallel sides. Simple expressions are derived for the limiting displacements as the system approaches hydrostatic equilibrium and for the form taken by the surface of the fluid at any time during the motion. Curves illustrating these quantities are plotted. It is pointed out that the subsidence of a load on the earth's surface having a span comparable to that of a continental ice sheet must produce appreciable flow at great depth. Using the previously derived figure for the mean viscosity of the earth it is found that with a load 2000 km-wide equilibrium would be very nearly reached in about 18,000 years, and that loads of smaller span would require proportionately greater time to reach the same stage. AUTHOR.

1564. Elasticity and Plasticity of Rocks and Artificial Stone. R. H. Evans. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 145–158, *Jan.*, 1936.—The non-linear stress-strain relations in granite, marble, sandstone, slate, millstone grit and concrete are explained by analysis of the strain into (*a*) strain which appears instantaneously on application of the stress; (*b*) creep which is recoverable on unloading ("elastic time-strain"); and (*c*) a creep which appears as a permanent set ("plastic time-strain"). The instantaneous, or "short-range" modulus is measured by making small variations in stress about a mean stress when all the creep has appeared. It is shown that the difference between the observed and theoretical velocities of seismic waves in the earth's crust may be removed by the use of this short-range modulus instead of the "secant" modulus usually employed. R. F. A.

1565. Exhalation of Helium from the Earth. E. K. Gerling. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 4. 1–2. *pp.* 41–43, 1935. *In German.*—As the amount of He exhaled from the earth varies at different places it was thought that places of greater exhalation should indicate deposits thereof. This was tested by determining the amounts of He (with Ne) exhaled immediately above placed situated (*a*) away from, (*b*) on the edge of, and (*c*) above, the Melnikovo He deposit. The average and extreme percentages (× 1000) of He + Ne were from (*a*) 2·23, (2·21 – 2·25); (*b*) 2·25 (2·24 – 2·26); (*c*) 2·28 (2·24 – 2·35), showing an average excess of about 2 % immediately above the deposit. C. A. S.

1566. Vapour Pressure-Water Content Relations of Soil Colloids. L. T. Alexander and M. M. Haring. *J. Phys. Chem.* 40. *pp.* 195–205, *Feb.*, 1936.—A study is made of the vapour pressure-water content curves of four typical soil colloids. The curves are shown to be characteristically different for the different soil groups. The change of free energy as a function of water content is calculated, and the total free energy change on wetting is determined approximately. An attempt is made to correlate vapour pressure curves with soil classification. Peirce's two-phase theory of water absorption by cellulose is used to picture the nature of the hygroscopic water of soil colloids. AUTHORS.

1567. Height Relations and Mass Content of the Greenland Ice Cap. F. Loewe. *Gerlands Beitr. z. Geophys.* 46. 3. *pp.* 317–330, 1936.—On the basis of planimetrical measurements made by the recent expedition to the Greenland ice cap, and using all earlier data, it is found that the ice cap covers $1\cdot65 \times 10^6$ sq. km. and has a mean height of 2110 ± 70 m. while the distribution with height is tabulated. For the hinterland of Disco- and Northeast Bay as well as for the whole ice cap there is a considerable surplus of accumulation over ablation but the ice production of calving glaciers suggests that for the whole ice cap the accumulation surplus is nearly equalled by this outflow from productive glacier fronts. For the western region 68°–72° N the outflow surpasses the whole accumulation. It is concluded that for the whole ice cap an approximately stationary condition exists and in any case there is no quick decrease.

R. S. R.

METEOROLOGY.

1568. Effect of Continent and Ocean on the General Circulation and the Theory of Monsoons. S. Sakuraba. *Geophys. Mag., Tokyo,* 9. *pp.* 237–262, *Dec.*, 1935. *In English.*—Modifying Spitaler's formula which gives the distribution of the annual mean temperature of the air arising from the distribution of land and sea, on the assumption that the surface of the earth consists of two continents separated by two oceans, the author finds the effect of this distribution on the general circulation of the atmosphere. The equations of motion being stated, both the case of the non-rotating and also of the rotating earth are investigated. The longitudinal velocity of the air on a rotating earth is seen to consist of three components. These are tabulated. An explanation is offered for the non-existence of antimonsoons in the sense of the term used by A. Wagner and also for the discrepancy between the positions of highest and lowest temperature and those of low and high pressure centres. An example of the latter is the Siberian high controlling the winter monsoons in the Far East. A suggested explanation is also given of the inclination of the core of low pressure centres towards the equator as observed in Indian monsoons. Diagrams illustrate the paper. A. E. M. G.

1569. Precipitation from Adiabatically Ascending Air. J. R. Fulks. *Monthly Weather Rev.* 63. *pp.* 291–294, *Oct.*, 1935.—" The paper attempts to present calculated estimates of hourly rates of precipitation in such a manner that the magnitude of various factors necessary to produce observed rates may be readily visualised." Layers 100 m. thick ascending at 1 metre per sec. are dealt with, the range of pressure being from 1000 mb. to 300 mb. and of temperature from $-30°$ C. to $+30°$ C. A formula has been established giving the rate of precipitation from such layers. The results enable a chart to be drawn so that estimates may be made for a layer of any thickness and having any rate of precipitation. Particular cases are discussed with the help of the chart. Two notes are added to the paper. In the first a formula giving the rate of precipitation similar to the author's is given by **H. R. Byers.** The second by **E. W. Woolard** refers to similar work by others and also points out that de/dT required for the construction of the chart can be obtained in a simpler way than that used by the author. A. E. M. G.

***1570. Size of Mist and Cloud Elements. V. Hagemann.** *Gerlands Beitr. z. Geophys.*, 46. 3. *pp.* 261–282, 1936.—An apparatus is arranged to draw the individual droplets of fogs and clouds into an oil, where they remain suspended and of which a microphotograph is taken. Special plates are used so that the true size of the drops may be shown. These photographs are then examined under a microscope and the size of the drops grouped under various radii. Examples of the photographs obtained are reproduced and curves given showing the distribution of the drops on various days, together, on two days, with graphs of the variation of temperature, visibility and moisture-content during the time of measurement. The apparatus can be used in balloons to find the sizes of drops in clouds. H. M. B.

*** 1571. Measurement of Atmospheric Dust Content. M. Berek, K. Männchen and W. Schäfer.** *Zeits. f. Instrumentenk.* 56. *pp.* 49–56, *Feb.*, 1936.—A portable apparatus is described, which makes use of the scattering of light by atmospheric dust to obtain a measure of the quantity of dust in unit volume of air. An advantage of this method is that instantaneous values can be found. By comparison with a gravimetric method it is shown that the light-scattering method is capable of giving accurate results. For five different types of dust the calibration curve of the instrument is linear, and practically the same line. Moreover, it is possible to use it to find approximately the distribution of size amongst the dust particles. The apparatus consists of dust chamber, lighting section, photometer portion, and observing telescope. The dust-chamber has side openings, which allow the circulation of the air through it. The light comes in through a window, which is inclined downwards, and the light reflected up off the face of this window outside the chamber provides the comparison light for the photometer. The observing telescope projects into the chamber opposite the entry window, and is focused on the middle of the chamber. The light observed through the telescope, scattered by the dust, is compared with the light which has been reflected off the window before entering the dust-chamber, and this reflected light is suitably weakened by rotating polarising prisms. The lamp is excited by a Ni-Fe battery carried in the body of the instrument. A. C. M.

1572. Dust and Smoke in the Atmosphere at Lyons. Renée Herman-Montagne and L. Herman. *Comptes Rendus*, 202. *pp.* 501–503, *Feb.* 10, 1936.—Observations were made with an Owen's dust counter. Curves are drawn representing the hourly means throughout the day over a month for the months of June to Nov. 1935. Two distinct maxima are found. The effect of domestic fires on these maxima is considered. The weekly variation in the pollution shows an increase from Monday to Friday then a decrease with a minimum on Sunday. A comparison is made between the curves for London (winter) Lyons (November) and Berlin. The effects of wind and fog are also referred to. Rain on commencing increases the atmospheric pollution, but steady rain is found to clear the atmosphere completely. A. E. M. G.

1573. Night Sky Spectrum and Schumann-Runge O_2 Bands. J. Cabannes and J. Dufay. *Comptes Rendus*, 202. *pp.* 365–368, *Feb.* 5, 1936.—The strongest Vegard-Kaplan N_2 bands in the night sky have $v' = 2, 3, 4$. If the Schumann-Runge O_2 bands are present and are excited by the same electrons, the strongest of them will have $v' = 6$ to 10 and $v'' = 20$, and will form groups near λλ3960, 4045, 4135, 4220, 4315, 4415, 4505, 4615. The night-sky spectrograms of relatively large dispersion (one of which is reproduced with the above positions marked) show radiations at λλ3872, 4127, 4371, 4407, 4457, 4514, 4675, 4707, 4711, 4816, 4823, 4904, whose emitters are unknown. There are several approximate concordances, indicating the probable presence of the O_2 bands. Consideration of the energy-limits of the exciting electrons indicated by the Vegard-Kaplan N_2 bands, and of the potential energies and internuclear distances of O_2 molecules in the $X^3\Sigma$ and $B^3\Sigma$ states, shows that the Schumann-Runge bands, if present, will have about 1/15 of the intensity of the Vegard-Kaplan bands and will be very difficult to detect. W. J.

1574. Small Variations of Atmospheric Transparency. N. N. Kalitin. *Gerlands Beitr. z. Geophys.* 46. 3. *pp.* 283–290, 1936.—Earlier determinations of solar radiation afforded a measure of general atmospheric transparency, but did not indicate the small variations taking place within a short time. The author describes an actinometer devised for the purpose of measuring these small changes. Observations of the intensity of the solar radiation and of the radiation from the sky within a radius of 6° from the sun's centre obtained on several dates show that the variations of the latter are large compared with those of the former. A similar result is found when comparison is made with the variations of the coefficient of transparency and of the turbulence factor. Graphs are drawn illustrating these rapid changes. From the observations carried out near Leningrad and also at Ssotschi on the Black Sea under similar cloudless conditions, the author concludes that the atmosphere is never uniformly transparent, the transparency continually suffering variations. A. E. M. G.

See also Abstracts 1480, 1567, 1586.

SEISMOLOGY.

1575. Pulsatory Oscillations of the Ground. K. Wadati and K. Masuda. *Geophys. Mag., Tokyo,* 9. *pp.* 299–340, *Dec.,* 1935. *In English.*—The main generating cause of microseisms is the breaking effect of strong waves on the sea-shore. Local microseisms are sometimes caused by the wind, but only when it is *very* strong. The hardness of the ground plays an important rôle, and where it is very soft microseisms are analogous to the surface disturbances of water in a tank. W. A. R.

1576. Elastic Oscillations in an Isotropic, Homogeneous, Elastic Half-Space under Superficial Stress. E. Hallén. *Zeits. f. angew. Math. u. Mechanik,* 16. *pp.* 5–19, *Feb.,* 1936.—The following problem is discussed mathematically. An infinite, homogeneous isotropic body, bounded by a plane surface is at rest at time $t = 0$; stresses are then applied over a limited region of the plane surface, these stresses being arbitrary functions of the coordinate of time and space; required to find the motion at every point of the body at all subsequent times. The problem is of geophysical importance. The problem is solved by the method of conformal transformation. J. S. G. T.

See also Abstracts 1486, 1564.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1577. Remarkable Auroral Forms from Southern Norway. C. Størmer. *Geofysiske Publ.* 11. 5. [19 *pp.*], 1935.—Besides the ordinary auroral forms observed in Norway during the last 25 years certain rather remarkable forms have also been seen. Among these are homogeneous auroral arcs occurring at about double the normal height. Three cases of these are discussed in detail in the present publication. For one of the arcs, it appears that the part lying in the sunlit atmosphere was higher than when the arc was in the earth's shadow. The author suggests that the unusual height points to the arcs being due to less penetrating radiation than the usual auroræ. The directions of the arcs are found to be nearly normal to the direction of the horizontal component of the earth's magnetic force at the earth's surface. Reproductions of certain of the photographs taken are appended; also line diagrams and tables compiled from the observations. Some notes are also given of visual observations of earlier similar auroræ. A. E. M. G.

See also Abstract 1881.

RADIOACTIVITY.

1578. Helium Content of Minerals not Emitting α-Rays. H. J. Born. *Naturwiss.* 24. *pp.* 73–76, *Jan.* 31, 1936.—A review is given of researches on the two groups of minerals which though containing He do not exhibit α-radiation. These groups are the Be-containing minerals and certain alkaline halides, and they were first investigated by Rayleigh, who has since extended his observations. Some difficulties in connection with the observed facts have been explained by supposing that the action of γ-rays from Ra occurs and that in the process ${}^9_4\mathrm{Be} + \gamma\text{-rays} \rightarrow {}^8_4\mathrm{Be} + n^1_0$ the ${}^8_4\mathrm{Be}$ as such is incapable of existence and at once disintegrates into two He atoms. The presence of He is thus supposed to be due to external γ-ray action. For the second group it has been found in recent experiments that KCl and NaCl on crystallising out from certain lead-containing aqueous solutions carried with them the Pb almost quantitatively. This fact has a bearing on geo-chemistry. The rock-salt and sylvine found must so have crystallised out and enriched the Pb existing in the sea. Analyses of natural salts have in fact shown the presence of Pb. Now the Permian Sea, like present-day seas, also contained masses of U and Ra besides the usual Pb from the U-producing lead isotope RaD. This was together with the Pb absorbed from rock salt and sylvine found by the disintegration of Po that later with the sending out of α-rays went over into the active RaG. Besides other difficulties in suggested explanations a great one occurs when it is considered that the He content of sylvine is 10,000 times greater than would be expected from the RaD content of the Permian seas, and it is suggested that it is a secondary product from kainite and carnalite, and that the secondary salts were formed in deep water rich in RaD and therefore had a high He content. This is supported by experiments of Russian observers on the Ra content of waters in various oil-fields. The author has confirmed these results by experiments on deep waters in Germany, and the He content of the sylvine seems due to lixiviation of the rocks washed by the water and the taking up of Ra. The order of magnitude of the Ra content found by the author is the same as that observed in Russia and the importance of the deep water for geochemistry of the radioactive elements is proved. Numerical details are given in the paper and a Bibliography of papers treating of the subject.

J. J. S.

1579. Preparation of Polonium Sources from Radon Bulbs. L. R. Hafstad. *Frank. Inst., J.* 221. *pp.* 191–214, *Feb.*, 1936.—A detailed description is given of the technique developed at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for the production of strong pure Po sources by the method of I. Curie. A complete double purification of the RaD from Rn bulbs can be carried out in several hours a day on four or five successive days. A recent source produced by the author had a surface-density of 30 mc. per cm.^{2}, with 95 % of the particles having ranges greater than 3·57 cm. according to measurements made by E. Pollard at Yale University. AUTHOR.

1580. Excited States of the Alpha-Particle. E. Feenberg. *Phys. Rev.* 49. *pp.* 328–331, *Feb.* 15, 1936.—The kinetic energy operator for the internal motion of the α-particle can be expressed without cross derivatives in terms of a suitable set of internal coordinates. The usual methods when applied to a restricted class of Hamiltonian operators then yield sum rules from which are deduced upper limits to the excitation energies of the 2*p* levels. These upper limits involve certain diagonal matrix elements which are easily evaluated by using an approximate normal state wave function. Computations on three different nuclear models indicate definitely the existence of a singlet 2*p* level in the discrete eigenvalue spectrum of the α-particle if the range of the intra-nuclear forces exceeds $2\cdot0 \times 10^{-13}$ cm. A simple variation calculation gives excitation energies which fall slightly below the upper limit fixed by the sum rules. AUTHOR.

1581. Validity of the Photographic Reciprocity Law for α-Rays. R. N. Wolfe and T. R. Wilkins. *J.O.S.A.* 26. *pp.* 105–110, *March.* 1936.—The validity of the photographic reciprocity law for α-rays is confirmed for a ratio of source intensities of 171 to 1. The law had previously been confirmed for a ratio of source intensities of only 7 to 1. The source intensities used were equivalent to $1\cdot38$ millicuries/cm.^{2} and $8\cdot06 \times 10^{-3}$ millicurie/cm.^{2}. The reciprocity law is found to hold for this ratio of source intensities when the exposures are made in a sequence which eliminates the effect of latent image growth. To avoid complications due to aggregate recoil the sources were coated with a layer of silver approximately $0\cdot1\mu$ in thickness. AUTHORS.

1582. Radiation from Actinon Active Deposit. J. Surugue. *Comptes Rendus*, 202. *pp.* 410–411, *Feb.* 5, 1936.—The large permanent magnet already described [see Abstract 2280 (1935)] is used to examine the β-ray spectrum of actinon active deposit. In general, results of previous experimenters are confirmed but the absolute energy values are higher by $0\cdot4$ %, thus standing in better agreement for the γ-ray lines with work on the fine structure of the α-rays. The HR measurements had a precision of $0\cdot1$ %, while the energy of the γ-rays was determined to within $0\cdot3$ %. Some evidence was found for a ray of 813 ekV energy, attributed to the transformation AcB→AcC. F. C. C.

1583. Excitation of γ-Rays by Neutrons. Part II. S. Kikuchi, K. Husimi and H. Aoki. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 35–49, *Jan.*, 1936. *In English.*—The γ-rays emitted by proton-neutron interaction are observed. The cross-section for the process is found to lie between $1\cdot0$–$0\cdot36 \times 10^{-25}$ cm.^{2}. The energy of the γ-ray quantum emitted by this interaction is determined by the method of coincidence of two counters and is found to be $(2\cdot2 \pm 0\cdot1) \times 10^6$ eV. The absorption curves of the secondary electrons due to γ-rays excited in Cd, Cl, Cu and Fe by slow neutrons are also determined. In the case of Cd, Cu and Fe γ-rays of more than 1×10^7 eV in quantum energy were observed. [For Part I see Abstract 4770 (1935).] AUTHORS.

***1584. Projection Cloud Chamber. M. S. Livingston.** *Am. Phys. Teacher*, 4. *p.* 33, *Feb.*, 1936.—A small portable cloud chamber is described suitable for projecting α-particle tracks on a screen for demonstration purposes. Details of construction are illustrated in a figure, and the technique of operation is discussed. AUTHOR.

See also Abstracts 1396, 1399, 1804, 1845.

RADIATION.

ABSORPTION AND TRANSMISSION.

1585. Colour of Corundum. I. I. Islamov and J. M. Tolmačev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 1. *pp.* 11–13, 1936. *In English.*—Comparison of the spark spectra of solutions (prepared by fusion with borax and solution in dilute HCl) of red, blue and grey corundum from Semiz-Bugu (N. Kazakstan) with those of suitable standard solutions for the elements determined quantitatively, and examination of the spectra for those determined qualitatively give the following results :—

Corundum	Determined quantitatively %				Determined qualitatively	
	Cr	Ti	V	Ga	Appreciable amounts of	Traces of
Red	0·18	0·01	0·04	0·005	Mg Ni Sn Si	Na Ca Sr Be Mn
Blue	0·002	0·20	trace	0·005	Ca Sr Ni Sn Si	Na Mg Be Mn Cu
Light greygreen -	trace	0·03	trace	0·002	Ca Sr Mg Si	Na Be Mn Ni Cu Sn

It is concluded that the red colour is due to Cr, the blue to Ti. Qualitative examination of greyish-blue and bluish-green kyanite from the same locality shows in the former appreciable amounts of Ca, Ti, Cr, less of Sr, Mg, Fe, V and Ga, and traces of Na, Mn, and Ni ; in the latter considerable amounts of Ca, Mg and Cr, appreciable of Na and V, less of Sr, Fe, Ti, Ni and Ga, and traces of Mn. C. A. S.

1586. Ultra-Violet Transparency of Ice. N. N. Kalitin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 3. *pp.* 145–146, 1935. *In French.*—To study u.v. radiation 18 photographs can be taken on one plate by a spectrometer capable of registering to 4000 Å. The plates are examined by a Moll microphotometer. Tables of results are given. For transparent ice 10 cm. thick, a mean of 98 % of the light is transmitted ; for ice full of bubbles of air 60 % passes. A block 107 cm. thick transmits about 50 %. The method is easily used on expeditions and can be extended to the infra-red for which sensitive plates are now available. H. M. B.

***1587. Application of Jamin Polarisation Interferometer to Measurements of Absorption. P. Barchewitz.** *Comptes Rendus,* 202. *pp.* 300–301, *Jan.* 27, 1936.—A modification of the Jamin polarisation interferometer as applied to measurements of absorption [see Abstract 4507 (1934)] dispenses with the quarter-wave plate and facilitates measurements at u.v. wave-lengths. C. B. A.

See also Abstracts 1441, 1612.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1588. Optic Moments of Organic Molecules in Relation to Crystalline and Magnetic Birefringence. M. Ramanadham. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 43–50, *Jan.*, 1936.—The results of observations of the magnetic birefringence of organic solids dissolved in CCl_4 are given.

The observed values of C_M for naphthalene solutions are compared with the value of C_M observed by Salceanu on molten naphthalene and found to be in good agreement. The principal optic axes of the diphenyl crystal are fixed on the basis of the author's own observations, those of Groth and also of Hendricks and Jefferson. The direction of maximum refractive index has been found to coincide with the direction which has been assigned to that of the length of the molecule by Krishnan from his diamagnetic observations on the crystal. The optic moments of the diphenyl molecule are calculated from the refractive indices and are found to satisfy the observed magnetic birefringence and the refractive index of the solution. The optic moments of the dibenzyl molecule are similarly calculated from the refractive indices and found to agree with the observed refractive index of the liquid dibenzyl. AUTHOR.

1589. Electro-Optical Effect in ZnS. C. Schramm. *Ann. d. Physik,* 25. 4. *pp.* 309–336, *Feb.,* 1936.—The theory of the electro-optical effect is developed according to Pockels' and the relation between the linear Kerr constant and the electro-optical constant is worked out. The experimental investigations are made using three different sources of monochromatic light. The brightness of the field of view is observed visually, photographically and with a photo-cell and the method of using the Babinet compensator is that due to Hehlgans. The crystals of ZnS all show marked " natural double refraction " and the conditions for producing and removing " artificial double refraction " are given. Numerous measurements and results of the double refraction due to an electric field are given for the principal orientations of the crystals. The crystal structure was examined by X-rays and the piezo-optic constant determined. The results are compared with those for nitrobenzol. R. L.

***1590. Magneto-Rotation in Rapidly Alternating Fields. E. Bretscher.** *Helv. Phys. Acta,* 9. 1. *pp.* 42–62, 1936. *In German.*—A brief summary is given of the effects of magnetic and electrical fields on the absorption by materials of transmitted light and of the explanations given in terms of the quantum theory. An apparatus is described for the measurement of the magneto-rotation in rapidly alternating fields (1000–60 m.); a compensation method utilising a photo-cell is employed. It is found that the Zeeman effect and the magneto-rotation are affected by an alternating field only in the neighbourhood of a spectral line. It is suggested that the results interpreted by Allison as time lag in the Faraday effect are due to other causes. H. J. H. S.

See also Abstract 1434.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1591. Quenching of Na Fluorescence. V. Kondratjew and M. Siskin. *Phys. Zeits. d. Sowjetunion,* 8. 6. *pp.* 644–666, 1935. *In German.*—NaI vapour is excited by radiations from Al, Zn and Fe sparks and the quenching of the D fluorescence of Na by admixture with A, N_2, NO and O_2 is investigated. In A the quenching is independent of the energy of Na′ (which is varied from 2 to 23 k.cal./gm. atom), and the quenching cross-section is about 0·1 of the gas-kinetic cross-section. In N_2 and NO the peculiar dependence of the quenching cross-section on the energy of Na′ is explained by the existence of two types of photochemical dissociation of NaI. In NO and O_2 the quenching is greatest and independent of the resonance between the vibrational energy of NaI and the electronic excitation energy of Na. The chief factor appears to be the magnitude of the forces of interaction of the colliding particles, the thermal effect of the possible reaction $Na' + AB \rightarrow NaA + B$ (where AB = quenching molecule) being taken as a measure of these forces. W. J.

*1592. **Fluorescent Emission of the Mercury Line 2537 Å at Pressures between 10^{-8} and 10^{-1} mm. P. Pringsheim and O. D. Saltmarsh.** *Roy. Soc., Proc.* 154*A*. *pp.* 90–95, *March* 2, 1936.—An apparatus is described in which the Hg vapour pressure may be regulated by changing the temperature of the surrounding oven, and as sources of light the Houterman and Osram lamps are used. In general the phenomena observed are quite analogous to those obtained for Na vapour. At high pressures a fluorescence appears for which not only the exciting but also the emitted frequency is different from the proper frequency of the atom. The conclusion is drawn that the fluorescence now observed is not to be described as a normal atomic resonance radiation, and is not due to Hg-atoms but to some sort of very loosely bound Hg_2-molecules with proper frequencies quite close to those of the single atoms—probably van der Waals molecules. They also think it possible that Rayleigh's core effect may be attributed to the absorption of light in mono-atomic mercury vapour. Intense beam fluorescence as first observed by Badger has been examined up to 120 mm. of nitrogen and found to be unpolarised. H. H. Ho.

1593. **Quantum Theory of Phosphorescence of Crystal Phosphors. T. Muto.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 613. *pp.* 171–206, *Dec.*, 1935. *In English.*—An attempt to give a theoretical interpretation based on the Wilson theory of semiconductors. The Schrödinger wave equation of the crystal phosphor in a radiation field is established and discussed and each of the unperturbed Hamiltonians and their mutual interactions are discussed. Solutions of the equation are obtained with the aid of the perturbation method of Weisskopf and Wigner. Certain general comparisons with experimental results are possible. [See following Abstract.] J. E.

1594. **Theory of Thermoluminescence in Crystals. T. Muto.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 614. *pp.* 207–220, *Jan.*, 1936. *In English.*—The same method is applied [see preceding Abstract]. As in Wilson's model electrons in an impurity atom occupy a level (γ) just below an unoccupied or partially occupied crystal level (C) to which the impurity electron must be excited before emission occurs by transition from level C to a lower unoccupied or partially occupied level or levels. Equations are developed and solved as before. The temperature conditions deduced lead to an explanation of the experimental fact that various groups of thermoluminescent bands are emitted at different temperatures. J. E.

1595. **Luminescence of Calcite. S. Kreutz.** *Acad. Polonaise Sci. et Lettres, Bull.* 7–8*A*. *pp.* 486–500, *July–Oct.*, 1935. *In German.* Luminescent calcite was found to lose its luminescent power by heating for about 2 hr. to red heat. The blue or blue-white luminescence at 300° passes over into a yellow luminescence at 330°–580° with a few calcites. The loss of luminescence with heating is attributed to loss of CO_2 since it can be restored by treatment with CO_2, or with long standing after heating. The author attempts to correlate spectral distribution with origin but this cannot be done with the more complicated but less individual spectra excited by X-rays. J. E.

See also Abstract 1762.

INTERFERENCE. DIFFRACTION AND SCATTERING.

1596. Molecular Scattering of Light in Liquids—Cabannes-Daure Effect. A. Rousset. *J. de Physique et le Radium*, 6. *pp*. 507–515, *Dec*., 1935.—The broadening of a spectral line due to scattering in a liquid is referred to as the Cabannes-Daure effect, and is regarded as distinct from the discontinuous rotation spectrum seen when light is scattered in a gas. It is attributed to the fluctuations in orientation of the molecules. If large permanent moments are present, the fluctuations in orientation of a large number of molecules are reduced to oscillations about equilibrium positions, in which case the anisotropic scattering of the oscillating molecule is found entirely in the Q branch, so that strongly polarised molecules show very little Cabannes-Daure effect. The effect is investigated with a spectrograph having dispersion 6 Å per mm., and the spectra are passed through a double-image prism before reaching the slit. The line of unmodified wave-length is composed of a strongly polarised part (coherent scattering) and a depolarised part (Q branch of the anisotropic scattering). Hence, in the image the coherent scattering is nearly completely absent, while the P, Q, R branches are present in strength 6/13 normal. With benzene, acetic acid and CCl_4 the depolarisation factor for the Cabannes-Daure radiations is 6/7. The curves of intensity distribution with wave-length have the same general character; there is no sign of the maximum to be expected on the theory of Raman rotational scattering. [See following Abstract.] A. C. M.

1597. Cabannes-Daure Effect and Critical Opalescence. A. Rousset. *Ann. de Physique*, 5. *pp*. 5–135, *Jan*., 1936.—From the measurements of the depolarisation ρ of the light scattered by four binary liquid mixtures, it is concluded that the scattering due to fluctuations in the molecular field does not increase as rapidly as the light due to opalescence near the critical point. Supposing the primary scattering to be completely polarised, the rapid increase in ρ near the critical point can be attributed to the existence of a secondary scattering, partly depolarised, whose intensity grows more rapidly than does that of the primary scattering. The opalescence variation with wave-length at the critical point is of the form λ^{-n}, where $2 < n < 4$. The comparison of intensities and colours scattered in two directions equally inclined to the incident beam, one in front of it and one behind, show that the theory of Ornstein and Zernicke is not verified for any of the mixtures studied, although a correction of this type may be present. The effect of a correlation between the fluctuations of two neighbouring elements of volume is masked by capillary forces which come into play in a heterogeneous distribution of molecules, and work against fluctuations of concentration, so making the work of fluctuation differ from zero at the critical point. [See preceding Abstract.] A. C. M.

1598. Polarisation and Intensity of Scattered Light in Turbid Media. H. v. dem Borne. *Zeits. f. Physik*, 99. 1–2. *pp*. 73–102, 1936.—The intensity of the light scattered by smokes and by vapours is measured in two spectral regions (about $0 \cdot 55\ \mu$ and 1μ respectively) using a copper-oxide photo-cell. The state of polarisation of the scattered light is measured visually. The results for the dependence of the intensity of scattering on the size and kind of smoke particles are in good agreement with those of other workers. The polarisations show a maximum where the intensity of the scattered light is a minimum, in agreement with the theory of Mie. The actual values of the scattering-function, however, show better agreement with Pokrowski's theory than with Mie's. A special study is made of light scattered by the atmosphere (sky-radiation). The scattering-function obtained above gives the possibility of investigating the dependence of sky-radiation on the height of the sun and the turbidity of the atmosphere, and allows the calculation of the total intensity of the sky radiation received by the earth. A. C. M.

***1599. Use of a Cylindrical Lens to Correct the Astigmatism of a Concave Grating in an Eagle Mounting. P. Jacquinot and A. Khamsavi.** *Rev. d'Optique,* 15. *pp.* 12–18, *Jan.,* 1936.—Examines the conditions of use of a cylindrical lens with the Eagle mounting of a concave grating, and the consequent gain in light intensity. The latter gain is due solely to the reduced size of the slit image, there being no additional gain from the use of a cylindrical lens apart from the intrinsic advantages of the stigmatism obtained. W. S. S.

See also Abstracts **1433, 1571, 1642, 1778, 1779, 1780, 1785.**

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1600. Chemical Reactivity and Light Absorption. N. R. Dhar and P. N. Bhargava. *Indian Journ. Phys.* 10. *pp.* 43–47, *Jan.,* 1936.—Absorption spectra of a few vapours and their mixtures are studied in order to investigate the nature of photochemical reactivity. AUTHORS.

1601. Photodissociation of $PbBr_2$ Vapour. B. Popov. *Acta Physicochimica,* 4. 1. *pp.* 159–168, 1936. *In German.*—$PbBr_2$ vapour heated in a quartz vessel and irradiated with a Zn spark emits yellow-green fluorescence, which is faint at 450° C. (v.p. = 0·14 mm.), but much stronger at 500–530° C. (v.p. = 0·7 to 1·4 mm.). A Cd spark is less effective, and an Al spark less still. The exciting radiations are between $\lambda\lambda$2026 and 2313. The spectrum is photographed in glass (*f*/3) and quartz (*f*/5) prism spectrographs. It consists of (i) Pb lines $\lambda\lambda$2833, 3640, 3683, 4058 involving transitions from s^3P_1 (4·36 V) and s^3P_0 (4·31 V) to metastable states p^3P_2 and p^3P_1 and the ground state p^3P_0; (ii) PbBr band-system $\lambda\lambda$4430–4950, vibrational analysis of which gives $\omega' \doteqdot 148$ and $\omega'' \doteqdot 406$ cm.$^{-1}$, in analogy to Popov and Neujmin's results $\omega' \doteqdot 248$, $\omega'' \doteqdot 531$ for PbCl and $\omega' \doteqdot 74$ for PbI; (iii) Br_2 bands $\lambda\lambda$5050–5600. The results confirm the photodissociation scheme previously given for $PbCl_2$ and PbI_2, namely $PbX_2 + h\nu \rightarrow PbX^* + X$ or X', and $PbX + h\nu \rightarrow Pb^* + X$. W. J.

1602. Effect of Simultaneous Irradiation with Different Wave-Lengths upon the Oxidation of Mandelic Acid by Bromine. J. C. Ghosh and S. K. Bhattacharyya. *Zeits. f. phys. Chem.* 31. *Abt.B.* 6. *pp.* 420–430, 1936.—The effects of irradiation with light of the wave-lengths 366, 436, and 546 mμ, either singly or simultaneously in pairs, are investigated for the oxidation of mandelic acid by bromine in aqueous solution and in presence of potassium bromide. This reaction is of zero order. With monochromatic irradiation the velocity constant is found to be proportional to the square root of the absorbed energy. When two wave-lengths are used together the total effect is always smaller than the sum of the individual effects. A mechanism of reaction is developed and values are calculated which agree well with observations. L. A. W.

1603. Photochemical Union of Hydrogen and Chlorine. Part IV. H. C. Craggs and A. J. Allmand. *Chem. Soc., J. pp.* 241–252, *Feb.,* 1936.—Experiments with carefully monochromatised light confirm the earlier conclusion that a H_2–Cl_2 mixture will react in light of wave-length 546 $\mu\mu$. On the other hand, negative results are obtained at 579 $\mu\mu$. Comparative measurements of the temperature coefficient of the reaction at 436 $\mu\mu$ and 546 $\mu\mu$ are carried out. In gas mixtures free from O_2 and of about 2 mm. total pressure, the relative quantum efficiency is found to be lower in u.v. than in visible light. At higher pressures no such difference is observed. At H_2 pressures of 0·01–0·5 mm., the presence of 0·1 mm. of O_2 does not retard the reaction although O_2 appears to be consumed. Evidence is obtained of a marked retardation when the H_2 pressure falls below 0·01 mm. The above results are discussed and explanations proposed. In connection with (1) and (2), it is suggested that active light absorption in the green is connected with the continuous background of the banded spectrum region, and that the reaction mechanism is essentially the same as when absorption takes place in the continuum proper. The observations under (3) are explained on the basis of a mechanism involving the formation of Cl_3 radicals in light of short wave-length. [For Part III see Abstract 1558 (1934).] AUTHORS.

1604. Properties of Illuminated Iodine Solutions. Part I. Photochemical Dissociation of I_2 Molecules in Solution. E. Rabinowitch and W. C. Wood. *Faraday Soc., Trans.* 32. *pp.* 547–556, *March*, 1936.—Using a photochemical compensation method already described [see Abstract 2060 (1935)] it is found possible to measure extinction changes of the order of 0·002 %. The reversible change in the extinction coefficient of I_2 solutions under the influence of strong illumination is examined. For I_2 solutions in CCl_4 and hexane, the effect consists in a decrease in the coefficient and is due to dissociation of I_2 molecules into atoms; its dependence on light intensity and on I_2 concentration are in accordance with this explanation. The recombination of I_2 atoms in solution is about 1000 times as great as that of Br in He at atmospheric pressure; this is in accord with the assumption that triple collisions are necessary for recombination in a gas but only single collisions in solution. The quantum yield of dissociation of I_2 molecules in solution is the same below 5000 Å (continuous) as above (band region in I_2 gas); two explanations are suggested. H. J. H. S.

1605. Photodecomposition of Iodoform and of the Alkyl and Alkylene Iodides. K. E. Gibson and T. Iredale. *Faraday Soc., Trans.* 32. *pp.* 571–576, *March*, 1936.—The quantum yield in the photodecomposition of iodoform in benzene in the absence of oxygen is not greater than unity. The different quantum yields for other iodides are discussed, and some explanations advanced for the variations. AUTHORS.

***1606. Simplified Sensitometry of Photographic Films. H. Fricke.** *Zeits. f. wiss. Phot.*, 35. *pp.* 70–79, *Feb.–March*, 1936.—Apparatus is described which makes it possible to record automatically the variations of sensitivity of photographic film over a spectrum either of uniform or of arbitrarily distributed intensity. It is found in practice that such apparatus is a technical possibility, and that it gives results which satisfy all the usual requirements. An automatic apparatus for the evaluation of the sensitograms obtained is also described. C. B. A.

1607. Action of Oxidising Materials on the Latent Image. H. Arens. *Zeits. f. wiss. Phot.* 35. *pp.* 1–14. *Jan.*, 1936.—Extends the examinations of previous authors on the action of oxidising materials on the latent image, it being found that the absolute weakening of the latent image increases at first with increasing illumination, reaches a maximum and then decreases. The relative weakening, however, decreases continuously with increase in illumination. These decreasing parts of the curves continue into the solarisation region, similar latent blackening in the normal illumination region and in the solarisation region having different slopes. In the examination of the variations of the latent image with development time and concentration of the oxidising material, a definite difference in the weakening curves of the normal and solarisation latent blackening is observed, the curves in each case showing characteristic forms. The development curves of oxidised layers have similar shapes to those of solarised untreated layers, both of the types of layers initially showing slower, followed by much faster development than the normal illuminated untreated layers. Finally it is found that the single grains are reduced by oxidation, the grains losing the power of being developed. or else they remain fully developable. R. C. F.

1608. Temperature and Formation of the Latent Image. S. E. Sheppard. *Kodak Research Lab., Comm. No.* 545. *Zeits. f. wiss. Phot.* 35. *pp.* 15–32, *Jan.*, 1936.—Discusses previously published results and shows that the negative temperature coefficient of the latent image formation at low intensities [see Abstract 687 (1935)] is not due to a chemical action but to the combination of the thermal lattice loosening with the lattice disturbance brought about by the primary light action. With regard to the nature of the positive temperature effect, it is not possible to explain the results obtained by the changes in the spectral absorption coefficients with temperature as these are too small. An explanation may, however, be possible from the fact that there is a large decrease of photochemical gain with temperature, the changes being of the same magnitude as those occurring in the formation of the latent image. The continuous deviation from the reciprocity law, which is independent of the temperature is due to the decrease of the effectiveness of the absorbed quanta with intensity, and should not be attributed to a secondary chemical reaction. R. C. F.

1609. Action of Light and Electrons on Silver Halides. J. J. Trillat and H. Motz. *J. de Physique et le Radium*, 7. *pp.* 89–92, *Feb.*, 1936.—From an X-Ray examination of AgBr gelatin emulsions it is found that, provided the emulsions are exposed in the solarisation region, they contain crystalline Ag, the quantity of Ag increasing with exposure time. In order to show whether Ag is present in the latent image, the emulsions are examined using the electron diffraction method. No Ag can be detected but it is found that the silver halide is changed from the amorphous to the crystalline form by the action of the electrons. R. C. F.

***1610. Ultra-Rapid Kinematograph. L. Bull and P. Girard.** *Comptes Rendus*, 202. *pp.* 554–555, *Feb.* 17, 1935.—The main difficulty with h.f. kinematograph images is their separation. In this case a modification of the Henriot and Huguenard principle is employed to get perfect stability of the rotor [see Abstract 1746 (1933)]. The film, 22 cm. in length, is placed inside the rotor with the emulsion directed to the centre. The shutter is regulated to the same speed as the rotor. It is possible to obtain 5×10^4 images per sec. with perfect distinctness and clarity in this way. R. S. R.

***1611. Exposure and Exposure Meters in Colour Photography. E. A. Bierman.** *Phot. J.* 76. *pp.* 119–125, *March*, 1936.—The latitude in exposure for colour working is considerably less than in monochrome photography so that light tables and calculators are not sufficiently accurate for colour photography. The actinometer, extinction and photoelectric cell meters are shown to have their uses in this work, but all of them require experience in use to obtain regular results, the effect of long and short focus lenses upon exposure also being briefly indicated. Finally the new Agfa Ultra and Dufay colour films are considered—development, speed markings, latitude in exposure and developers being dealt with. R. C. F.

***1612. Photographic Exposure Factors. J. G. Holmes.** *Journ. Sci. Instruments*, 13. *pp.* 89–91, *March*, 1936.—The variables affecting the value of the exposure factor of a photographic filter are discussed and the indeterminate errors in the measurement of the factor are avoided by precautions in the design and use of the camera. The results obtained appear accurate to ± 3·5 % and enable an interesting comparison to be drawn between the values of the factor of a filter under different conditions of use. AUTHOR.

See also Abstracts 1440, 1480, 1581, 1720, 1733.

PHOTOMETRY.

1613. Correction of Errors Due to Heterogeneous Blackening of the Plate in Photographic Photometry. J. Lagrula. *Comptes Rendus*, 202. *pp.* 389–392, *Feb.* 5, 1936.—A method is suggested for correcting the errors due to uneven blackening of the plate in stellar photometry. G. C. McV.

***1614. Relation between Illumination and Current for Photovoltaic Cells. E. Elvegård.** *Phys. Zeits.* 37. *pp.* 129–133, *Feb.* 15, 1936. —Describes experiments on various types of photo-cells of the rectifier class (selenium and Cu_2O) with the object of determining the relation between the illumination and the current for various values of the resistance in the external circuit. The author finds that for any given cell and value of external resistance the relation can be expressed by the equation $B = i\ (k_1 - k_2\sqrt{i})^{-2}$, where B is the illumination and i the corresponding current. J. W. T. W.

***1615. Present Status of Photometry. W. E. Forsythe.** *Am. Illum. Eng. Soc., Trans.* 31. *pp.* 181–196 ; *Disc.*, 197–199, *Feb.*, 1936.—The measuring of the output of a light source depends upon accurate standards and accurate methods of making the measurements. In this paper the establishment of working and reference standards is discussed, and the various methods of making the measurements are outlined. These methods include both eye observation and certain types of physical photometers. AUTHOR.

See also Abstract 1606.

POLARISATION.

1616. Polarisation of X-Rays from Thin Targets. D. S. Piston. *Phys. Rev.* 49. *pp.* 275–279, *Feb.* 15, 1936.—By the use of Ross's method of balanced foils and a modification of the 90° scattering method, the polarisation of the portion of the continuous X-ray spectrum between the K limits of Ta and W is measured for targets of Al foil (0·7μ) and Ag foil (0·17μ), at voltages from the quantum limit up to 120 kV. For both elements, the polarisation is complete at the quantum limit, and decreases as the tube voltage is raised above the quantum voltage for the spectrum band.

The decrease is more rapid for Ag than for Al, and in the case of the latter the decrease is greater than that predicted by Sommerfeld. A method is described whereby the finite thickness of the target may be taken into account. The resulting correction, however, is too small to account for the discrepancy between theory and experiment. AUTHOR.

***1617. Metallic-Mirror Spectropolarimeter for the Extreme Ultra-Violet. R. Servant.** *Comptes Rendus*, 202. *pp*. 476–477, *Feb*. 10, 1936.—Aluminium-coated concave mirrors are used in place of lenses in this instrument to eliminate the high absorption in the u.v. of the optical parts and to avoid the difficulties of achromatising. The polarisation is effected by reflection at plane glass mirrors and spectral resolution with the aid of a Bloch spectrograph employing a metallic concave grating. The instrument is intended for use at wave-lengths below 1850 Å. W. S. S.

See also Abstract **1598.**

RADIATION, EMISSION.

1618. Relation of Spontaneous and True Magnetisation to Emissivity. W. Gerlach. *Ann. d. Physik*, 25. 3. *pp*. 209–212, *Feb*., 1936.—For normal metals the Hagen-Rubens relation between emissivity and electrical resistance holds, but the ferromagnetic metals nickel and iron are anomalous in the neighbourhood of the temperature at which the spontaneous magnetisation disappears. The emissivity of nickel between 100° and 450° C. exhibits qualitatively and almost quantitatively the same relation to the energy of spontaneous magnetisation as the electrical resistance, and the emissivity of nickel is reduced by true magnetisation. [See following Abstract.] G. E. A.

1619. Emissivity of Nickel. E. Löwe. *Ann. d. Physik*, 25. 3. *pp*. 213–222, *Feb*., 1936.—There were measured the total black-body radiation, the total radiation of Ni, and radiation of various ranges of wave-length from Ni. The emissivity for $\lambda < 4\cdot5\mu$ increases in a linear manner with the temperature, but with increase of wave-length the E_λ curve develops a point of inflexion near the Curie point. For wave-lengths $8\cdot7\mu$ and 24μ the E_λ-temperature curve corresponds to that for electrical resistance-temperature. Magnetisation of Ni in a field of 2000 to 4000 gauss causes a reduction in the emissivity for long waves to a minimum value at 347° C. [See preceding Abstract.] G. E. A.

1620. Spectral Emissivities, Resistivity and Thermal Expansion of Tungsten-Molybdenum Alloys. P. N. Bossart. *Physics*, 7. *pp*. 50–54, *Feb*., 1936.—The spectral emissivities of three different W-Mo alloys are found by direct measurement with an optical pyrometer to be from about 120 % at 1300° K. to 110 % at 2200° K. of the values calculated as a simple mixture of the constituents. In the case of one alloy this result is compared with a similarly determined ratio of measured to calculated resistivities. According to Drude's law, the square root of this resistivity ratio should be the corresponding emissivity ratio. It is found at temperatures 1300° K. to 2100° K. that the square root of the resistivity ratio is practically constant at 1·215, which checks approximately the emissivity ratio 1·19 at 1300° K. only. The emissivities of W and Mo are measured. The resistivity-temperature, and thermal expansion-temperature relations are given for the alloy 46·5 % (atomic) of W. The resistivity relation is compared with those of its constituents and discussed with reference to the theory of Bragg and Williams. AUTHOR.

***1621. Galvanometer with Double Moving Coil for Infra-Red Measurements. I. Devaux.** *J. de Physique et le Radium,* 7. *pp.* 146–148, *March,* 1936.—The resonance method of galvanometry for infra-red spectra determinations, employing two galvanometers so arranged that the light reflected from the mirror of the first falls upon that of the second is briefly explained. A method of eliminating some of the difficulties is described, and a single galvanometer, incorporating two coils suspended one from and below the other in the field of a magnet, which enables the difficulties to be overcome is illustrated. J. S. G. T.

1622. Measurement of Cosmic-Ray Showers by Geiger-Müller Counters. C. G. Montgomery and D. D. Montgomery. *Frank. Inst., J.* 221. *pp.* 59–64, *Jan.,* 1936.—Expressions are derived for the probability that a shower of N particles will discharge a set of r counters, in terms of the probabilities of rays passing through individual counters. An expression is also given for the probability as modified by an absorber placed over one of the counters, in terms of the probability that a particle striking the absorber will penetrate it. Curves of the derived expressions are plotted for special values of the quantities concerned. D. H. F.

1623. Penetration of Solar and Cosmic Rays into Fresh Water Lakes. G. A. Linhart. *J. Phys. Chem.* 40. *pp.* 113–119, *Jan.,* 1936.—It is shown that an equation given elsewhere, expressing the relation between the turbulence and depth of the ocean, applies equally well to the decrease in temperature, and to the penetration of solar heat and cosmic radiation, with increase in depth of fresh water lakes. It is contended that this is not accidental. D. H. F.

1624. Recent Developments in Cosmic Rays. A. H. Compton. *Rev. Sci. Instruments,* 7. *pp.* 71–81, *Feb.,* 1936.—Summary of recent developments in cosmic rays, with special reference to (1) composition; considerations of the latitude effect, variation of intensity with altitude, and absorption experiments with counter and with expansion chamber, lead to the conclusion that cosmic rays consist almost entirely of electrically charged particles, the proportion of neutrons or photons being almost negligible even at high altitudes; (2) analysis, at sea-level the radiation consists largely of positrons and electrons in about equal proportion; a feeble but highly penetrating component found after considerable absorption is tentatively ascribed to protons, while an easily absorbed component found only at high altitudes probably consists of α-particles; (3) energy distribution, magnetic analysis with an electromagnet and expansion chamber shows the existence of particles of all energies up to 5×10^9 eV, while using the earth's magnetic field and the latitude effect, energies of 10^{10} eV are established; (4) effects produced by cosmic rays; extra-nuclear ionisation and nuclear effects with the production of high energy photons are the main processes, the photon → secondary particle → photon transformation being continued several times; the loss of energy by radiation for electrons of energies greater than 7×10^7 eV is much less than predicted by existing quantum electrodynamics; a photon of such high energy is more easily absorbed than an electron of the same energy; (5) the place of origin and the method of production of cosmic rays. F. C. C.

1625. Cosmic Radiation at a Height of 3500 m. P. Auger, L. Leprince-Ringuet and P. Ehrenfest, Jr. *J. de Physique et le Radium,* 7. *pp.* 58–64, *Feb.,* 1936.—An account is given of cosmic ray observations made in 1934 at the Laboratoire International du Jungfraujoch at a height of 3500 m. Coincidence counters were used and the absorption of the soft radiation determined for screens of Pb, Sn, Cu, and Al. A systematic variation of the absorption coefficients with the atomic number is deduced. Using a set of four counters a study of the secondary radiation and of bursts is made with reference to the thickness of the lead radiator and the influence of the character of the laboratory walls. J. E. R. C.

***1626. Variation of Cosmic-Ray Intensity with Direction in Stratosphere. W. F. G. Swann and G. L. Locher.** *Frank. Inst., J.* 221. *pp.* 275–289, *Feb.,* 1936.—The apparatus used in the National Geographic Society U.S. Army Air Corps stratosphere flight is described in some detail. It consists of automatically recording sets of counters, forming " cosmic-ray telescopes," arranged to receive rays at different zenith angles ; there are two sets for each angle, one set being provided with an auxiliary set of counters designed to prevent the registration of coincidences due to showers. Owing to an accident, most of the records were destroyed, but rough zenith angle distribution curves at 40,000 ft. could be derived. A noteworthy feature is the relatively high intensity in a horizontal direction. This is attributed to comparatively soft secondary particles which have been bent round to a horizontal direction by the earth's magnetic field and remaining unabsorbed on account of the thinness of the atmosphere at that height. The total ionisation relative to that at sea-level is greater from the counter measurements than from ionisation chamber measurements and possible reasons for this are discussed. D. H. F.

1627. Nature of Large Cosmic-Ray Bursts. H. Carmichael. *Roy. Soc., Proc.* 154*A. pp.* 223–245, *March* 2, 1936.—Cosmic-ray bursts are investigated at sea-level with a large (175 l.) ionisation chamber. The results of 1500 hours' observation are given. A new sensitive, quickly responding electrometer is used, and a new method of recording such that bursts of all sizes, above the lower limit set by the normal fluctuations of the ionisation current, are measurable. Experiments are made with different gases in the ionisation chamber and with several thicknesses of lead from 0 to 8 cm. above the chamber. The result of the former experiments is used to complete the experimental evidence necessary to establish that the bursts are produced by thinly ionising particles such as are found in cosmic-ray showers in the Wilson chamber, and the result of the latter experiments shows that the large bursts of 160 to several thousand ionising rays are almost certainly complex examples of the shower-phenomenon. Some additional results obtained with a small (1·75 l.) ionisation chamber are also reported. AUTHOR.

See also Abstract 1845.

RADIATION, GENERAL THEORY.

1628. Nature of Light. J. J. Thomson. *Nature,* 137. *pp.* 232–233, *Feb.* 8, 1936.—Extending the idea that the photon consists of a circular line of force travelling at right angles to its containing plane, the author considers harmonic trains of such rings. It is shown that Maxwell's equations are satisfied by electromagnetic wave trains of this character in which the radiation is practically confined to a cylindrical pencil about the axis of propagation and the lines of electric force are circles in planes normal to the axis. The radial flow of energy is found to be rigorously zero. Interference of such ring trains would occur, thus removing a difficulty of the earlier theory. Ring trains of finite length representing the radiation emitted from an atom following an electron jump can be obtained by the addition of infinite ring trains of different frequencies. W. S. S.

1629. Theory of the Electromagnetic Field. F. J. v. Wisniewski. *Zeits. f. Physik*, 98. 11–12. *pp.* 746–752, 1936.—The conditions under which an electromagnetic deformation can be propagated in space in accordance with the laws of analytical mechanics are investigated mathematically. The result is applied to the photon. J. S. G. T.

1630. Interaction of Spin-Particles. P. Jordan. *Zeits. f. Physik*, 98. 11–12. *pp.* 709–713, 1936.—It is suggested that the primary particles underlying the phenomena of both light and matter are particles of half-integral spin moment. This leads to a " neutrino " theory of light and indicates a close analogy between β- and γ-radiation. It also leads to the conclusion that, in a β-radiation process with $E \gg M_0c^2$, the electron and the neutrino are ejected in parallel directions. G. C. McV.

1631. Consequences of the Dirac Theory of Positrons. W. Heisenberg and H. Euler. *Zeits. f. Physik*, 98. 11–12. *pp.* 714–732, 1936.—The Dirac theory of positrons leads to the conclusion that every electromagnetic field will produce a tendency for the creation of pairs of particles. In order to avoid this, Maxwell's equations must be altered. A form for these equations is suggested for the case when there are no actual electrons or positrons in the field and the latter does not vary much over a Compton wave-length. G. C. McV.

1632. Light Quant and Neutrino. P. Jordan. *Zeits. f. Physik*, 98. 11–12. *pp.* 759–767, 1936.—The author's theory of the relation between the light quant and the neutrino is further developed in the light of investigations by Krönig. Two types of neutrino are assumed, analogous to negative and positive electrons, in that one type is probably to be interpreted as " holes " in the negative energy states. In any radiation process the difference in number of the " positive " and " negative " neutrinos remains constant. The theory is applied to the cavity radiation in the one dimensional case. It is shown that a pure radiation field in the cavity will occur if and only if the net neutrino " charge " is zero. Pure neutrino fields can also arise in which absorption of a light quant by an atom is impossible. Extension of the theory to the three-dimensional case is possible and will be given later. W. S. S.

1633. Derivation of the Interchange Rules in the Neutrino Theory of Light. P. Jordan. *Zeits. f. Physik*, 99. 1–2. *pp.* 109–113, 1936.—The fundamental formula for the relationship between the neutrino field and the matrices giving the light-quantum field can be more easily handled by introducing *discrete* eigenfrequencies. This overcomes the earlier difficulty of avoiding certain divergencies. [See Abstract 1602 (1935).] C. B. A.

1634. Proper Mass of the Photon and the Electromagnetic Tensor. J. Géhéniau. *Comptes Rendus*, 202. *pp.* 559–560, *Feb.* 17, 1936.—The Maxwellian and the Born-Infeld electromagnetic fields are examined on de Broglie's assumption of a minute proper mass for the photon. N. M. B.

1635. Photonic Interpretation of the Maxwell Field. W. H. Benedictus. *Comptes Rendus*, 202. *pp.* 560–562, *Feb.* 17, 1936.—It is shown that the asymmetrical Maxwellian tensor T^{α}_{β} can be transformed to give components of the vector quantity velocity of energy, which is equal to that of the impulse of the photon, and in Minkowski space the de Broglie condition is satisfied. If the tensor is symmetrical in α and β

it follows that the luminous field is propagated in the Einstein empty space. N. M. B.

See also Abstract 1766.

REFLECTION. REFRACTION AND DISPERSION.

1636. Residual Rays from Magnesium Oxide. M. Parodi. *Comptes Rendus*, 202. *pp.* 302–304, *Jan.* 17, 1936.—Born's theory for cubic crystals of the NaCl type is modified for bivalent ions and applied to MgO. The value obtained for the wave-length of the principal maximum of selective reflection is in very good agreement with that observed experimentally by Barnes, Brattain and Seitz [see Abstract 4584 (1935)]. Born's theory can also be used to predict the wave-length of the second maximum observed by these authors. C. B. A.

1637. Maximum-Minimum Method of Determining the Cardinal Points of a Lens System. G. F. C. Searle. *Cambridge Phil. Soc., Proc.* 32. *pp.* 138–143, *Jan.*, 1936.—A special case of the general coaxial system is taken in which the refractive index is the same for the media at the two ends. The theory of the method is given and illustrated for two thin lenses at a distance apart but having the same focal length. Full details of the experimental method and the determination of the Bravais points are supplied, and illustrated by a practical example. R. S. R.

1638. Space-Symmetrical Imaging. H. Boegehold. *Zeits. f. Instrumentenk.* 56. *pp.* 98–109, *March*, 1936.—The investigation of spherically-symmetric systems is now extended to space-symmetrical imaging. It is shown that, since spherically-symmetrical imaging can only give two spherical surfaces, but never a plane, sharp imaging of a plane is incompatible with space-symmetry. [See Abstract 2540 (1935).] C. B. A.

1639. Refraction in Solutions of Strong Electrolytes. A. E. Brodsky, J. M. Scherschewer and N. S. Filippowa. *Acta Physicochimica*, 3. 5. *pp.* 685–692, 1935. *In German.*—A general discussion. W. R. A.

1640. Variation of Refractive Index of Glass at Temperatures below 300°. N. Tudorovskaja. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 1. *pp.* 27–30, 1936. *In French.*—Glasses of composition Na_2O. SiO_2, PbO. SiO_2 and a barium crown are tested to find the alteration in their refractive indices after heating. It is found that for constant temperature there is an increase of refractive index independently of the increase or decrease during heating. Also, the time taken for the refractive index to become constant does not depend appreciably on temperature or composition of the glasses but on the size of the change of refractive index in comparison with the final value. H. M. B.

1641. Microscopic Determination of Refractive Index of Resinous Substances and Highly Refringent Minerals. N. Vedenejeva. S. Grum-Gržimajlo and A. Volkov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 4. 4–5. *pp.* 207–210, 1935. *In French.*—The method is a modification of that of Lebedeff [see Abstract 817 (1931)], using a plano-convex lens,—of pyrex or quartz for preparations liquid at high temperatures, pressed into the preparation under examination, with special care that the horizontal side of the lens is accurately parallel with the glass on which the preparation rests. With this arrangement the refractive indices for light of λλ6700, 5890, 5775 and 5460Å have been determined for a series of immersion preparations consisting of (100–4x)

piperine + $4x$As(or Sb)Br_3, where $x = 6 - 21$. Results confirm the author's previous results, and particularly the change in refraction with time. The method is also suitable for molten mixtures of S and Se, resins, varnishes, etc. C. A. S.

1642. Refractive Indices of Metallic Films Showing Newton's Rings. K. Prosad and B. N. Ghosh. *Indian Journ. Phys.* 10. *pp.* 49–53, *Jan.*, 1936.—Previous work [see Abstract 3766 (1934)] on the concentric ring system observed on the kathode of a Hadding's X-ray tube with Cu antikathode and Al kathode is extended using a platinum antikathode. AUTHORS.

1643. Refractive Index and Molecular Refraction of Selenium Hydride and Deuteride. O. E. Frivold, O. Hassel and T. Skjulstad. *Phys. Zeits.* 37. *pp.* 134–136, *Feb.* 16, 1936.—The refractive index of SeD_2, after being carefully prepared and dried, is measured by a Jamin's interferometer. The value of the refractive index n_0 at N.P.T. is obtained by considerations of pressure, coefficient of expansion and so forth of the gas. This is again corrected for the instability of the gas. The molecular refraction R is given by the equation $R = 22415\,(n_0^2 - 1)/(n_0^2 + 2)$. A monochromator is used as source with $\lambda = 6562{\cdot}8$ Å (Hα), $\lambda = 5460{\cdot}7$ Å (Hg, green line) $\lambda = 5893$ Å (Na, D-line). The results show that D_2Se has refractive index less for all values than H_2Se but that the graphs of refractive index-wave-length are similar. H. M. B.

1644. General Formula for Oblique Deviation. H. S. Uhler. *J.O.S.A.* 26. *pp.* 89–90, *Feb.*, 1936.—The formula $\sin \tfrac{1}{2} D = \sin \tfrac{1}{2} E \cos \eta_1$—in which D, E and η_1 denote, respectively, the actual or oblique deviation of a ray of light, the deviation of the orthogonal projection of this ray on a principal plane, and the (angular) altitude of the ray at incidence upon the optical system—is shown to be susceptible of quite broad interpretation, and applicable to any number of prisms and plane reflectors. A. H.

1645. Double Refraction of Minerals in Convergent Light. L. H. Borgström. *Soc. Scien. Fennica, Comm. Phys.-Math.* 8. 18. [15 *pp.*], 1935.—Double refraction in crystal grains can easily be determined from measurements of the optic axis picture under the microscope. Simple formulæ are deduced for both uniaxial and biaxial crystals, and a table is reproduced which gives the double refraction of uniaxial crystals directly from the measurements. C. B. A.

1646. Birefringence of Liquids Caused by Mechanical Deformation. C. Sadron. *Comptes Rendus*, 202. *pp.* 404–406, *Feb.* 5, 1936.—The birefringence, $n_e - n_o$, produced in a liquid of viscosity η, contained between two concentric cylinders, radii r_o, r_i, the inner of which rotates with angular velocity ω, $= K\omega r_i/(r_o - r_i)$, where K is a constant, provided that ω/η does not exceed a certain limit. It is shown that in the experiments of Raman and Krishnan [see Abstract 1878 (1928)] this limit was exceeded some sixfold, and agreement with their theory was fortuitous. The following values of Kx100 have been determined: (at 18°) heptyl alcohol 4·5 (Raman and Krishnan's theory 7·4), octyl alcohol 6·5, phenylethyl alcohol 17·5; (at 20°) oleic acid 360, cinnamic aldehyde 51·6, duodecyl alcohol 29·6. C. A. S.

1647. Theory of Dispersion. K. F. Herzfeld and Maria Goeppert-Mayer. *Phys. Rev.* 49. *pp.* 332–339, *Feb.*, 15, 1936.—The measured absorption is the difference between absorption and forced emission. This has to be taken into account in the interpretation of measurements in the

infra-red and the absorption of hot gases, particularly in the sun. According to Maxwell's theory, $n^2 = \epsilon\mu$. The influence of the magnetic susceptibility on the dispersion is discussed for a gas. The paramagnetic part depends on the frequency formally in the same way as the electric part, but is determined by the magnetic absorption lines. The diamagnetic part is practically independent of the frequency up to X-ray frequencies.
AUTHORS.

1648. Extreme Infra-Red Dispersion of Polar and Non-Polar Liquids. C. H. Cartwright and J. Errera. *Roy. Soc., Proc.* 154*A*. *pp.* 138–157, *March* 2, 1936.—By the residual-ray method, monochromatic radiations of 52, 63, 83, 100, 117, and 152 μ are obtained and used for measuring the absorption and reflection of several polar and non-polar liquids. From these data the index of refraction and the atomic polarisation are calculated. The values for the atomic polarisation thus found agree much better with the values determined for molecules in the gaseous state than those determined by the methods previously employed for liquids. From the measurements on the absolute intensity of absorption, the relaxation times and the apparent radii of the polar molecules are determined. Diluting the liquids in little-absorbing non-polar solvents shows that (1) a characteristic absorption band in pure water disappears and is therefore to be attributed to a quasi-crystalline structure; and (2) in all the other substances the characteristic absorption bands remain in dilute solution and are therefore due to intramolecular vibrations.
AUTHORS.

***1649. Mirrors Formed by Evaporation in Vacuo. L. Dunoyer.** *Comptes Rendus*, 202. *pp.* 474–476, *Feb.* 10, 1936.—The vacuum should be such that the mean free paths of the residual molecules of air are of the order of the distance of the source of metal vapour from the surface to be covered. The distribution of the metal being similar to that of light from the same source, to secure a uniform coating the source must be either so distant as to make the distances from all points approximately the same, or be replaced by several suitably distributed sources, or either it or the surface be suitably moved about. A point source allows of patterns being produced by interposition of suitable screens. C. A. S.

See also Abstracts 1441, 1448, 1471, 1525, 1588, 1721, 1757, 1769.

SPECTROSCOPY.

1650. Long and Short Spectral Lines. Part II. S. Datta and K. N. Chatterjee. *Indian Journ. Phys.* 10. *pp.* 65–73, *Jan.*, 1936.—In continuation of previous work [see Abstract 3481 (1935)] the long and short lines of some more elements, *viz.*, Zn, Ag and Fe are classified. The fundamental generalisations laid down there from a study of the long and short lines of Cu that if the relative orientations of the resultant L and S vectors in the initial and final states are compared then those for which the change in the orientation is large are short lines, whereas those for which the orientation change is small come to the category of long lines, is in general shown to be valid in these cases also. AUTHORS.

***1651. Spectrum of Rubidium in the Mercury Arc. I. A. Balinkin and D. A. Wells.** *J.O.S.A.* 26. *pp.* 77–78, *Feb.*, 1936.—Describes the construction and details the necessary operating conditions for using a sealed, l.v. Rb-Hg amalgam lamp, which may be of use in spectroscopic investigations. A. H.

1652. Spectra of Phosphorus. Part I. Neutral and Singly Ionised Phosphorus. H. A. Robinson. *Phys. Rev.* 49. *pp.* 297–305, *Feb.* 15, 1936.—Previous work on P I and P II is extended. Twenty-two new terms classifying thirty-six lines of P I are located. The ionisation potential is lowered tentatively from 11·1 to 10·9 V, and it is believed that this latter value is still slightly high. Term separations are in agreement with values calculated by the method of Goudsmit and Humphreys. Iso-electronic sequences with S II, Cl III and A IV indicate that some changes in S II classifications are necessary. 52 new terms have been located in P II. These classify 194 lines in the Schumann and visible regions of the spectrum. Nearly all of the expected singlet terms have been found. More than 20 intersystem combinations allow the singlet and triplet sequences to be located accurately with respect to one another. The P II ionisation potential is 19·56 V; this is lower than the previously accepted value. A. H.

1653. Analysis of 3d-4f in C II, N III and N II. B. Edlén. *Zeits. f. Physik*, 98. 9–10. *pp.* 561–568, 1936.—In completing the $3d'$–$4f'$ combinations in C II and N III, intercombinations have been found which show the quartet systems to be displaced $+ 19{\cdot}3$ cm.$^{-1}$ in C II and $- 396{\cdot}4$ cm.$^{-1}$ in N III relatively to the corresponding doublet systems. Through this linking a better value of the difference $2s^7\mathrm{S} - 2p^3\mathrm{P}$ for N IV is found and by interpolation for B II also. A complete analysis of the $3d$–$4f$ combination in N II is given, while certain lines in Fowler and Freeman's tables are shown to belong to A. Finally certain term-shifts in N IV and O IV are discussed. F. S.

1654. Ionisation Levels and Excitation Energies of Spectral Lines from Distribution of Emission in the Arc. H. Stephan. *Zeits. f. wisss. Phot.* 35. *pp.* 33–69, *Feb.–March*, 1936.—Preliminary investigations showed that (*i*) the intensity of spark lines near the kathode is determined by the ability of the kathode to emit electrons and thus by its temperature; (*ii*) the increase in intensity of arc lines near the poles is due to higher density of the vapour; (*iii*) the pole effect most probably arises from the same cause. For the investigation of ionisation levels and excitation energies on the basis of the distribution of intensity in arc lines, three conditions are essential: (*i*) a stable arc; (*ii*) the lowest possible electrode temperature; (*iii*) the lowest possible density of the vapour. These conditions are fulfilled at low current densities, and the arc spectra of Mg, Ca, Cu and Zn could then be separated with certainty, and the arc lines of these elements classified. The results agree with those obtained by King by the temperature method. C. B. A.

1655. Intersystem Combination Lines in A III. J. C. Boyce. *Phys. Rev.* 49. *p.* 351, *March* 1, 1936.—Intersystem combination lines of A III are discovered in the extreme u.v. The lines are listed and the singlet term values previously published are revised to conform to the same basis as that of the triplet terms. Wave-lengths of the "forbidden" lines of this stage of ionisation of A are calculated. One of them is in close agreement with a nebular line at $\lambda 7135{\cdot}6$. AUTHOR.

1656. Intensity Distribution of Neon Lines. E. Lau and W. Schütz. *Phys. Zeits.* 37. *pp.* 110–111, *Feb.* 1, 1936.—The differences in observed values by Schütz and his collaborators [see Abstract 3489 (1935)] and by Lau [see Abstract 3285 (1934)] are discussed. They are, in part, referred to difference in conditions of excitation, introducing variations due to Stark effect. F. S.

1657. Nuclear Moments. S. Frisch. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 1–2. *pp.* 21–22, 1935. *In German.*—It is shown that if the nuclear moments I of elements having odd atomic and mass numbers are assumed equal to L ± S, where the proton spin S = 1/2 and L is the resulting moment of the proton orbit and the remainder of the nucleus, these elements can be systematically collected together in groups having the same L values. The only exceptions to this grouping scheme, which is illustrated by diagram and tabulation, are Y and Tu whose nuclear moments are not yet known with certainty. J. E. K.

1658. Structure of the Mercury Resonance Line 2537 Å. S. Mrozowski. *Helv. Phys. Acta,* 9. 1. *pp.* 27–32, 1936. *In German.*—The various methods by which the intensity ratios of the hyperfine structure components of the Hg resonance line at 2537 Å have been determined are critically reviewed. It is considered that certain intensity measurements made by Zuber [see Abstract 3494 (1935)] cannot be credited with the high degree of accuracy claimed for them and that the correction of the hyperfine structure analysis proposed by Inglis [see Abstract 4509 (1933)] on which Zuber explained his anomalous results is neither necessary nor justified. J. E. K.

1659. Magnetic Dipole Radiation and Dispersion of Light near Magnetic Dipole Lines. B. Milianczuk. *Acad. Polonaise Sci. et Lettres, Bull.* 7–8.*A. pp.* 430–444, *July–Oct.,* 1935.—*In German.*—Mathematical. W. R. A.

1660. Calculation of Atomic Energy Levels. Parts II and III. T. Yamanouchi. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 10–34, *Jan.,* 1936. *In English.*—The method described in Part I [see Abstract 4581 (1935)] for the calculation of atomic energy levels becomes very troublesome as the number of inequivalent electrons outside the closed shell increases. Furthermore, the separations of the terms are generally large in such cases, many terms coming out of the different configurations intermix, so that the perturbation calculation ceases to be valid. The mathematical treatment of the problem is discussed in detail in Part II. Calculations of the energy levels for N I, O II and S II show moderate agreement with experiment. In Part III the problem is discussed anew with further restrictions upon the states of the core. A. H.

1661. Tables for Intensities of Lines in Multiplets. H. N. Russell. *Mt. Wilson Observat. Contrib. No.* 537. *Astrophys. J.* 83. *pp.* 129–139, *March,* 1936.—Tables are given showing the common logarithms of the ratio of the theoretical intensities of the strongest line of a multiplet to each other line, and to the sum for the whole multiplet, according to the quantum formulae for unperturbed LS coupling. Multiplicities from 2 to 11 are included, and term types as far as I (except for multiplicities 10 and 11). The numerical values for multiplicities 9, 10 and 11 are also given; and certain noteworthy regularities in multiplets of the same type but different multiplicity are discussed. AUTHOR.

1662. Spectrum of Acetylene-Air Flames in an Electric Field. A. E. Malinowski and W. S. Rossichin. *Phys. Zeits. d. Sowjetunion.* 8.5. *pp.* 541–546, 1935. *In German.*—The band spectrum of CC and CH in the inner and outer cones of the flame of C_2H_2 + air (22–25 %) mixture is photographed in the visible. No difference is found when a field of 800–1300 V/cm. is applied. The continuous spectrum from both cones appears always to be less intense in the field than without it. F. S.

1663. $A^1\Pi \rightarrow X^1\Sigma$(IV Pos.) Bands of Carbon Monoxide. L. Gerö. *Zeits. f. Physik*, 99. 1–2. *pp.* 52–64, 1936.—A number of bands of the system $A^1\Pi \rightarrow X^1\Sigma$ in the spectral region from 1950 to 2700 Å are photographed with a 6·5 m. grating. The analysis is carried out in order to obtain the rotational constants of the initial and final states up to as high vibrational quantum numbers as possible and in order to investigate the perturbations of the $A^1\Pi$ term. L. A. W.

1664. Dissociation Energy of CO and Predissociation of the $A^1\Pi$ State. R. Schmid and L. Gerö. *Zeits. f. Physik*, 99. 3–4. *pp.* 281–284, 1936.—New spectrograms of fourth positive bands, $A^1\Pi \rightarrow X^1\Sigma$, taken with a 30,000 lines/in. concave grating of Hochheim alloy [see Abstract 1215 (1936)] show numerous perturbations and sudden weakenings of band-lines, which are attributed to cuts of $A^1\Pi$ levels (whose J diminishes as v increases) by a predissociation limit 9·57 V above the lowest $X^1\Sigma$ level. The products of the three predissociations 9·57, 11·06 and 11·54 V (intervals 1·49 and 0·48 V) are $C(^1S) + O(^3P)$, $C(^3P) + O(^1S)$ and $C(^1S) + O(^1D)$ respectively (intervals 1·49 and 0·46 V). This leads to 6·9 V as the most probable value of the dissociation energy of $CO\ (X^1\Sigma) \rightarrow C(^3P) + O(^3P)$. This low value seems to be supported by various band-spectroscopic data, and if it is accepted the value 7·35 V for the dissociation energy of N_2 no longer appears to be too low. The observed heat of sublimation, 177 k.cal., probably refers to $C_{solid} \rightarrow C(^5S)$, since the value now calculated for $C_{solid} \rightarrow C(^3P)$ is only 73 k.cal. Kaplan's bands $e \rightarrow a^3\Pi$ are the progression $v' = 2$ of the third positive system $b^3\Sigma \rightarrow a^3\Pi$. W. J.

1665. Mechanism of the Emission of Light in Chemical Reactions. R. Audubert. *Comptes Rendus*, 202. *pp.* 406–407, *Feb.* 5, 1936.—The light quanta which are emitted during some simple chemical reactions of the type $A + B \rightarrow C$ [see Abstract 1203 (1936)] are too large to be the sum of the heat of reaction and the energy of activation of the molecule C produced, but could be produced if sufficient molecules remain in metastable excited states. Collisions of two such molecules (" collisions of the fourth kind ") could give rise to unexcited molecules with emission of quanta of the right order of magnitude, and the mean life of the metastable state required is found to be of the order of 10^{-2} sec. Other possible mechanisms are also discussed. C. B. A.

1666. Oscillation Frequencies of MnO_4 Ions. O. Specchia and G. Scandurra. *N. Cimento*, 12. *pp.* 601–605, *Dec.*, 1935.—Recently it has been shown by P. M. Taylor that for a crystal of $KMnO_4$ a band at 12·7 $m\mu$ appears which is approximately the same as the difference between bands seen in the visible. If the permanganate is dissolved in various solvents, the bands are found to be slightly displaced according to Kundt's law, depending on the refractive index of the solvent. For the crystal itself the bands reflected from different faces vary slightly, this is possibly due to dichroism. H. M. B.

1667. Infra-Red Absorption Maxima of Alkali Halides. J. A. Wasastjerna. *Soc. Scien. Fennica, Comm. Phys.-Math.* 8. 19. [11 *pp.*], 1935.—Infra-red absorption maxima are calculated according to a theory of the author [see Abstracts 2831 and 2832 (1935)] and the wave-lengths so obtained are in good agreement with experimental values. W. R. A.

1668. Atomic Polarisation and Infra-Red Absorption of Liquids. C. H. Cartwright and J. Errera. *Acta Physicochimica*, 3. 5. *pp.* 649–684, 1935. *In French.*—24 liquids are studied between 52 and

152μ in regard to their transmission and reflective power. The absorption bands arise from intramolecular vibrations and oscillations. From values of the refractive indices in the visible and infra-red the atomic polarisations are evaluated and are compared with existing data.

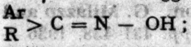
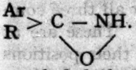
W. R. A.

1669. Infra-Red Reflection Spectrum of Silicates. Part II. F. Matossi and H. Krüger. *Zeits. f. Physik*, 99. 1–2. *pp.* 1–23, 1936.—The infra-red reflection spectra of 26 silicates and one tungstate are investigated in the region from 8 to 26μ by a recording method. In interpreting the results the authors adhere to the allocation of the fundamental vibration frequencies of the SiO_4 group put forward by Schaefer, Matossi and Wirtz [see Abstract 3290 (1934)]. The previously found displacement of the short-wave bands of the SiO_4 tetrahedron towards shorter wave-lengths with increasing association is confirmed. The condition for the appearance of the " inactive " pulsation frequency is associated with special ring-structure. The appearance of the band between 14 and 18μ indicates in the simpler structures the presence of octohedral grouping. In the interpretation of the spectra of the borosilicates the fundamental frequencies of the BO_4 group are taken into account. Lithium tungstate, which is isomorphous with Be_2SiO_4, shows only the frequencies of the WO_4 group.

L. A. W.

1670. Absorption Spectra of Hydrocarbons in the Near Infra-red. Part II—Gaseous Paraffins, Olefines and Acetylenes. P. Gänswein and R. Mecke. Part III—Halogen Derivatives of Methane, Ethane and Ethylene. O. Vierling and R. Mecke. Part IV—Calculation of Anharmonic Valence Vibrations of Polyatomic Molecules. R. Mecke. *Zeits. f. Physik*, 99. 3–4. *pp.* 189–235, 1936.—Absorption spectra, between 7000 and 10,000 Å, are recorded photographically for the following compounds :—ethane, propane, *n*-butane, *n*-pentane, *n*-hexane ; ethylene, propylene, *i*-butylene, butadiene ; acetylene, diacetylene, vinylacetylene ; ethylene oxide ; 6 chloro- and bromo-derivatives of methane, 5 chloro- and 3 bromo-derivatives of ethane, 3 chloro-derivatives of ethylene, propyl and propylene chlorides, some as gas and some as liquid. The various degrees of saturation of the C-C linkages evidence themselves in the position of the third CH-overtone : paraffins absorb at 8950–9150 Å, olefines at 8600–8750 Å and acetylenes at 7850–7900 Å. The number of CH-bonds shows itself only in increased absorption and not in the positions nor in resolution of the bands. The constitutional effects on the CH-bond of halogen substitution are essentially smaller than those of saturation of the C-C bond. A small increase in strength of binding of CH is observed, but this disappears with increase of halogen content. In unsymmetrical compounds such as trichlorethane, however, these differences are sufficient to permit definite bands to be attributed to individual groups (*e.g.*, HCl_2C–, H_2ClC–). These results are investigated theoretically in Part IV, in which the anharmonic overtones are calculated on the basis of the valence-force molecular model. Account is taken of constitutional influence of the potential interaction energy, of coupling with other atoms in the molecule, and of anharmonicity of the binding. The discussion covers the two cases of two harmonic vibrations of different and the same eigenfrequencies, and the coupled anharmonic overtones of different eigenfrequencies, in which the case of resonance is of special importance. With strong coupling, the system is defined by the eigenvalues v_s and v_a of the symmetrical and antisymmetrical

fundamental vibrations; but with weak coupling, the resolution of overtones is quite different, since the use of the two quantum numbers v_1 and v_2 of the unperturbed ground frequencies is more suitable, and the overtone has almost the same magnitude as that of a single valence. This is the case for all CH-vibrations, so that an extensive allocation of bands to individual CH-groups is possible. [For Part I see Abstract 4582 (1935).]
C. B. A.

1671. Constitution of Oximes and their Near Infra-Red Absorption Spectra. Marie Freymann and R. Freymann. *Comptes Rendus*, 202. *pp*. 312–314, *Jan*. 27, 1936.—Several oximes are investigated between 0·8 and 1·2μ. Some show only a strong band due to OH oscillation at 0·96μ and it is suggested that these have predominantly the constitution  $^{\mathrm{Ar}}_{\mathrm{R}}\!>\mathrm{C}=\mathrm{N}-\mathrm{OH}$; others show in addition a band characteristic of the NH oscillation and exist as an equilibrium mixture of the above and  By examining the spectra at different temperatures it is concluded that, on account of the increased intensities of the bands at higher temperatures, the oximes exhibit molecular association at ordinary temperatures.
W. R. A.

1672. Absorption Spectra of 1 : 2 : 3-Benztriazoles. A. K. Macbeth and J. R. Price. *Chem. Soc., J. pp*. 111–119, *Jan*., 1936.—Absorption curves and data given for 1 : 2 : 3-benztriazole and its derivatives show that this substance absorbs in two main regions, 245–263 and 270–291$\mu\mu$, the former being attributed to an electron in the C : C system of the benzene nucleus, and the latter to the N : N of the triazole ring; the introduction of alkyl substituents into the nucleus results in improved separation of the two regions. For the nitro-compounds no absorption characteristic of this group is observed unless an aqueous solvent is used or a methoxyl or hydroxyl groups is present in the triazole ring. 1-Hydroxy—1 : 2 : 3-benztriazole exists in alcoholic solution as an equilibrium mixture of the two tautomeric forms, about 20 % of the 1-oxide being present. 1-Hydroxy—6-methyl-1 : 2 : 3-benztriazole behaves similarly. The nitro-hydroxy-triazoles exist as the stable hydroxy-form in both alcoholic and aqueous solutions; marked displacements of the maxima, on change of solvent from alcohol to water, are probably connected with the ionisation of the compounds in the latter medium.
N. M. B.

1673. Infra-Red Absorption Spectra of Mixtures of Acetone and Water. D. Williams and E. K. Plyler. *J. Chem. Phys*. 4. *pp*. 154–157, *March*, 1936.—A study of the infra-red absorption spectra of acetone containing water reveals an associational band in the region 2·7μ. This band is studied for concentrations of water varying from 0·5 to 70 % by weight. The intensity of the associational band increases with the water content of the mixture. When the water content is large, the 3μ water band overlaps the associational band. Absorption spectra are obtained for ten mixtures. It is found that concentrations of water as low as 0·1 % can be detected by the presence of this band.
AUTHORS.

1674. Infra-Red Absorption Spectra of Deuteroxide Solutions in Deuterium Oxide. E. K. Plyler and D. Williams. *J. Chem. Phys*. 4. *pp*. 157–160, *March*, 1936.—The infra-red absorption spectra of D_2O and deuteroxide solutions in D_2O are measured in the region from 2·5μ to 9μ. Also solutions of Na_2CO_3 and K_2CO_3 in D_2O are studied in the same region. The spectra of D_2O possess strong bands at $4\cdot0\mu$ and $8\cdot2\mu$ and the results agree with those of other workers. The absorption at $4\cdot0\mu$ is probably composed of several overlapping bands. Intense bands are observed in the NaOD solutions at $3\cdot1\mu$, $4\cdot95\mu$ and $7\cdot1\mu$. The hydrolysing salts in D_2O give rise to bands in these regions, but with some shifts in wave-length. The changes in the spectra are probably caused by the absorption of the CO_3 ion and D_2CO_3 which is formed in the solution. The relation of the absorption of NaOD in D_2O to the absorption of NaOH in H_2O is discussed. It is concluded that the OD ion has an absorption band at $3\cdot1\mu$ and that the bands at $4\cdot95\mu$ and $7\cdot1\mu$ are produced by hydration. AUTHORS.

1675. Absorption Spectra of Chromium, Molybdenum and Tungsten Hexacarbonyls in Vapour and Solution. G. Milazzo and G. Scheibe. *Zeits. f. phys. Chem.* 31. *Abt.B.* 6. *pp.* 431–438, 1936.—The absorption spectra of $Cr(CO)_6$, $Mo(CO)_6$ and $W(CO)_6$ vapours, and of their solutions in hexane and in alcohol, are recorded. For all three compounds, three similar regions of absorption are observed. These are at about 31,000, 34,500 and 43,500 cm.$^{-1}$ respectively, and their positions and intensities are little affected by solution. The absorption bands show no indication of structure, and are assumed to be true continua. The positions of the bands are discussed on the assumption that the primary photoprocess is dissociation, but their assignment to definite decomposition products is not possible. C. B. A.

1676. Absorption Bands of O_2–O_2. H. Salow and W. Steiner. *Zeits. f. Physik*, 99. 1–2. *pp.* 137–158, 1936.—The wave-lengths of the absorption maxima between λλ6299 and 3150, the forms of the bands and the intensities of absorption are determined with various oxygen pressures between 40 and 160 atm. and with added foreign gases up to 100 atm. It is found that the wave-lengths remain unchanged, while the absorption intensity increases with square of oxygen pressure and is independent of added foreign gas ($\log I_0/I = ap^2$, where a is the absorption coefficient at the absorption maximum for the individual bands). Hence two O_2 molecules are involved in the absorption process, and the bands are due to the collision-pair O_2–O_2. Molar extinction coefficients for this are calculated. The results are discussed in connection with Ellis and Kneser's interpretation of the bands as " combination bands " due to simultaneous electronic transitions in two O_2 molecules [see Abstract 660 (1934)]. W. J.

1677. Effect of Magnetic Field on S_2 Absorption Bands. J. Genard. *Physica*, 3. *pp.* 125–130, *March*, 1936. *In French.*—The ultraviolet S_2 absorption bands on each side of the principal predissociation limit in the system $\mathrm{B}^3\Sigma^-_u \leftarrow \mathrm{X}^3\Sigma^-_g$ are photographed in a quartz prism spectrograph, of dispersion 4 A/mm. at λ2900, without and with a constant transverse magnetic field of 25,500 gauss, the temperature of the quartz absorption cell being constant (600° C.). On the high-ν side of the predissociation limit ($9 \leftarrow 0$, $10 \leftarrow 0$, $11 \leftarrow 0$, . . . in Naudé and Christy's $v'\,v''$ numbering which is used without the required increase of 1 in v') no effect of the field on the intensity, and character of the bands is observed, their diffuseness being neither displaced nor accentuated. On the short-ν side of the limit, however, the field has the remarkable and rather unexpected effect of increasing the intensities of all the bands ($v' = 0$ to 9, $v'' = 0$ to 3), some much more than others. The effect is shown in reproduced microphotometer records and in a $v'\,v''$ scheme of visual estimates of the intensifications. It is discussed with the aid of the $U : r$ curves of the electronic states of S_2. With increase of temperature and pressure, a band-system appears at λλ 3600–4000, which d'Or has recently attributed to S_4 ; its band-intensities are unaffected by the field. W. J.

1678. Absorption Spectra of Substituted Benzenes. H. Conrad-Billroth. *Zeits. f. phys. Chem.* 31. *Abt.B.* 6. *pp.* 475–476 (1936).—Discrepancies between measurements of the absorption spectra of *p*-xylol, mesitylene and pseudocumene as made by Wolf and his co-workers and by the author are cleared up with the help of results obtained by Steurer [see Abstract 5027 (1935)] and of new measurements on mesitylene. C. B. A.

1679. Absorption of Light by Porphyrins. Part IV. A. Stern and H. Wenderlein. *Zeits. f. phys. Chem.* 175. *Abt.A.* 6. *pp.* 405–437, **1936.**—Continuing previous work [see Abstract 5025 (1935)] absorption curves are measured for porphin and substituted porphyrins. In all, 24 substances are investigated, including a number with one or two substituents containing a carbonyl group. It is found possible to distinguish between two types of absorption curve, whose relation to the structure of the molecules is discussed. One conclusion is that in the case of porphyrins with two carbonyl groups it is possible from the type of the absorption curve to deduce to which nuclei the carbonyls are attached. L. A. W.

1680. Absorption of Light by Porphin Colouring Matters and its Relation to their Constitution. A. Hagenbach, F. Auerbacher and E. Wiedemann. *Helv. Phys. Acta,* 9. 1. *pp.* 2–26, 1936. *In German.*—The absorption spectra of porphin compounds already recorded by other workers, together with new measurements in the u.v. for several of the compounds, are discussed in the light of their chemical structure with special reference to electron distribution in the molecules. C. B. A.

***1681. Absorption Spectra of α-Carotene, β-Carotene and Lycopene. J. H. C. Smith.** *Am. Chem. Soc., J.* 58. *pp.* 247–255, *Feb.,* **1936.**—By means of a new photoelectric spectrophotometric apparatus the absorption spectra of highly purified α-carotene, β-carotene and lycopene dissolved in 20 % ether in ethanol and in CS_2 are determined. The absorption coefficients found agree well with the results obtained previously for the ether-ethanol solutions but differ considerably from those reported for CS_2 solutions. The causes for the differences in CS_2 solutions are not apparent. An explanation is offered for the variations in positions of the absorption maxima of α-carotene and β-carotene determined spectrophotometrically and spectroscopically, supplemented with a copper ammonium filter. The cause probably lies in the superposition of the absorption of the filter on that of the pigment. Because of the variations possible in the latter method of measurement due to changes in concentrations of the solutions, only the positions of the absorption maxima determined photometrically should be reported. AUTHOR.

1682. Far Ultra-Violet Absorption Spectra and Ionisation Potentials of H_2O and H_2S. W. C. Price. *J. Chem. Phys.* 4. *pp.* 147–153, *March,* **1936.**—The absorption spectra of H_2O and H_2S in the region below **1600Å** are found to consist of various electronic series accompanied by comparatively little vibrational structure. The electronic series conform fairly well to Rydberg formulæ the limits of which give 12·56 ± 0·02 and 10·42 ± 0·01 volts, respectively, for the ionisation potentials of these molecules. The analysis fits in very well with Mulliken's prediction that the bands should be due to the excitation and removal of a nonbonding electron localised near the O or the S atom. A tentative rotational analysis given for some of the bands in H_2S indicates that the moments of inertia suffer little change by the excitation. Suggestions with regard to plausible atomic term series related with the molecular series are put forward. AUTHOR.

1683. A-Bands of Sulphur. E. Olsson. *Zeits. f. Physik*, 99. 1–2. *pp.* 114–118, 1936.—Seven bands in the emission spectrum of S, which are all denoted as A-bands, and which are distinguished from the principal bands by their simpler structure, are analysed. The predissociation limits for both systems is fixed at 2825 Å. In the ground state, alternate (uneven) rotation levels are absent, indicating zero nuclear spin. C. B. A.

1684. Intensity of Rotation-Lines of a Band and Excitation Conditions. O. Herrmann. *Phys. Zeits.* 37. *pp.* 100–103, *Feb.* 1, 1936.—By means of measurements of intensity ratios in the N_2 spectrum a relation is found between the intensities of the lines in the R-branch of 0 → 0 bands, of the negative group and the energy of the exciting electrons. From the intensity ratios of the lines in the band and the known total emission, the absolute emission of the lines of the P-branch is calculated. F. S.

1685. Vibrations of Polyatomic Molecules. E. Bauermeister and W. Weizel. *Phys. Zeits.* 37. *pp.* 169–184, *March* 1, 1936.—A review of recent work dealing with the calculation of the frequencies of vibrations of polyatomic molecules, in which simple models are assumed. A. C. M.

1686. Heitler-London Repulsive State of Hydrogen. H. M. James, A. S. Coolidge and R. D. Present. *J. Chem. Phys.* 4. *pp.* 187–193, *March,* 1936.—A variational method is used in the study of the $1s\sigma 2p\sigma\,^3\Sigma_u$ state of H_2. Two computations with formally different functions give, for a nuclear separation of $1\cdot5\ a_H$, energies which agree to within 0·03 eV. The way in which the computed energies converge to a limit, as the complexity of the varied functions increases, indicates that the interaction energy of the atoms at this distance is $+\ 5\cdot145 \pm 0\cdot02$ eV. Computations are also made for nuclear separations of $1\cdot6\ a_H$ and $1\cdot87\ a_H$. A potential curve passed through points thus determined and approaching the Heitler-London curve asymptotically for large nuclear separations is believed to be accurate to 0·2 eV for nuclear separations greater than $1\cdot35\ a_H$. This curve is compared with the curve constructed by Finkelnburg and Weizel to account for the variation with wave-length of the excitation potential of the continuous spectrum. A. H.

1687. Franck-Condon Principle. A. S. Coolidge, H. M. James and R. D. Present. *J. Chem. Phys.* 4. *pp.* 193–211, *March,* 1936.—The validity of the Franck-Condon principle is investigated in connection with its application to the calculation of spectral intensities in the continuous radiation due to the transitions between the $1s\sigma 2s\sigma\,^3\Sigma_g$ and the $1s\sigma 2p\sigma\,^3\Sigma_u$ states of H_2. For the latter state a potential curve is constructed based on theoretical considerations. For the former state a curve is computed from spectral data. Accurate wave functions for both states are computed. Transition probabilities from the first four vibrational levels of the stable state are determined by mechanical integration. The spectral intensities so obtained are compared with those given by several forms of approximate calculation. Comparisons are also made with the experimental results. It is concluded that the use of the principle leads to results definitely incompatible with these experimental observations. A. H.

1688. Continuous Molecular Spectra of Hydrogen and Deuterium. Arlette Tournaire and E. Vassy. *Comptes Rendus,* 202. *pp.* 562–564, *Feb.* 17, 1936.—Data are given for the comparative intensities of H_2 and D_2 lines over the wave-length range 4990–1923 Å. The difference between the intensities of the two spectra, which is negligible for the shorter wave-lengths, increases on approaching the visible region, reaches a maximum at 4100 Å, and then decreases slowly, the spectra becoming very weak towards 5000 Å. The intensity diminishes with decreasing pressure more rapidly for H_2 than for D_2; hence, with fall of pressure the D_2 spectrum becomes more intense relative to that of H_2; at 4100 Å the intensities are equal for 0·65 mm. pressure [see Abstract 225 (1936)]. N. M. B.

1689. Intensity Distribution of the Continuous Spectrum of Hydrogen in Mixtures with Helium and with Neon. N. D. Smith. *Phys. Rev.* 49. *pp.* 345–350, *March* 1, 1936.—A study is made of the continuous spectrum of H_2 emitted in mixtures with He and Ne, the effect of these gases being to shift the intensity maximum to longer wave-lengths. Determinations are made of (*a*) the ratio of intensity of the spectrum emitted by pure hydrogen to that emitted in the presence of helium, as a function of the wave-length; (*b*) the distribution of energy in the continuous spectrum of hydrogen in the presence of helium, by comparison with the radiation emitted from the positive crater of the carbon arc—this being the best available approximation to black-body radiation in the ultraviolet; and (*c*) the intensity distribution in the many-line spectrum in the presence of helium. It is found that 20 cm. of He are sufficient to reduce the vibration in the excited states to practically zero. Hence the continuum emitted in the presence of He must come from the lowest vibrational level of the upper state. In the case of (*b*) the intensity maximum is found at λ3200 as compared with λ2500 for the spectrum under ordinary conditions; this is in agreement with the results of other workers. A. H.

1690. U.V. Absorption of Organic Substances. L. Marchlewski and B. Skarzynski. *Acad. Polonaise Sci. et Lettres, Bull.* 7–8*A*. *pp.* 474–478, *July–Oct.*, 1935. *In English.*—An examination is made by means of a Spekker spectrophotometer of the absorption spectrum of toluene between λ2360 and λ2730. Comparison with results obtained earlier establishes the fact that all the monoalkyl benzene derivatives have very similar spectra, that of toluene being quite typical. A. H.

1691. Theory of Continuous Absorption Spectra of Diatomic Molecules. H. Trivedi. *Acad. Sci., Proc., U.P., India*, 5. *pp.* 171–186, *Dec.*, 1935.—With only a few exceptions the halides of the alkalis, saturated oxides and sulphides do not show band absorption, but merely one or more regions of continuous absorption. A calculation is given, based on wave mechanics, of the intensity of continuous absorption by such molecules. The paper is entirely mathematical. A. H.

1692. Continuous Absorption Spectrum of Hydrogen Iodide. C. F. Goodeve and A. W. C. Taylor. *Roy. Soc., Proc.* 154*A*. *pp.* 181–187, *March* 2, 1936.—The extinction coefficients of HI are measured. The approximate course of the upper potential energy curve is calculated from the eigenfunction of the ground state and the observed extinction. The results favour the dissociation into normal atoms and indicate the difficulties of extrapolation of absorption thresholds in the determination of heats of dissociation. AUTHORS.

1693. Extinction Coefficients of Iodine and Other Halogens. E. Rabinowitch and W. C. Wood. *Faraday Soc., Trans.* 32. *pp.* 540–546. *March*, 1936.—The extinction coefficients of I_2 vapour at

room-temperature are measured between 4300 and 6200 Å. They are found to be 2 to 6 times greater than the values generally in use. The influence of temperature upon the extinction is discussed. Small humps observed on the extinction curves of Br_2 and I_2 are shown to be due to absorption by vibrating molecules. The influence of the density is discussed. It is shown that the correct mean extinction curve in the band region can be obtained either by using a very low iodine pressure or—more conveniently—by adding an inert gas. Measurements are made with He, A and air, at 500 mm. The absorption in the continuous part of the spectrum is found to remain unaffected by the foreign gas, but the mean extinction coefficients in the band regions are considerably increased. The "limiting" extinction curve of I_2 vapour obtained in this way has a maximum at 5200 Å, and a shape resembling that of the extinction curve of iodine dissolved in CCl_4. The influence of the solvent upon the extinctions of the three halogens is compared. The extinction coefficients are appreciably increased by dissolution, especially in the cases of Cl_2 and Br_2. This is explained as being due to a molecular Stark effect enhancing the probability of the singlet-triplet intercombination, especially in light atoms.
AUTHORS.

1694. Fluorescence and Absorption Bands of Coumarin Derivatives. (Mrs.) W. Czapska-Narkiewicz. *Acad. Polonaise Sci. et Lettres, Bull.* 7–8 *A. pp.* 445–447, *July–Oct.*, 1935. *In French.*—The substances were excited to fluorescence by a Hg lamp while the absorption spectra were obtained with an incandescent lamp. The bands are broad with ill-defined maxima. Replacement of H by OH displaces He maximum by 200 Å in absorption and by 48 Å in fluorescence. J. E.

1695. Fluorescence Spectra of Deuteroporphyrin and of Pyroporphyrin. C. Dhéré and O. Biermacher. *Comptes Rendus,* 202. *pp.* 442–444, *Feb.* 5, 1936.—Fine structure is recorded in fluorescence bands (in the orange and red of the visible spectrum) of deuteroporphyrin and of pyroporphyrin XV. The fluorescence is attributed to the formation of photoporphyrins during the irradiation. C. B. A.

1696. Stark Effect Calculation for the Balmer Series. K. Basu. *Calcutta Math. Soc., Bull.* 26. *pp.* 79–138, *Sept. and Dec.*, 1934.—An entirely mathematical account is given of a new method for calculating the Stark effect of all orders from a consideration of the perturbation of a free H-like atom by external electric force. It is concluded that the perturbation method cannot be used in the case of very high fields in the Stark effect problem for H or, for that matter, for hydrogenic atoms. A. H.

1697. Displacement of the Component H_γ π 18 in the Stark Effect. K. Basu. *Zeits. f. Physik,* 98. 9–10. *pp.* 576–579, 1936.—The displacements of the Balmer lines in the Stark effect can be represented by $\Delta\nu = aJ - bJ^2 + cJ^3 - dJ^4$, where J = field strength and a, b, c, d are constants. This expression is examined for the H_γ line in fields between $0{\cdot}1$ and $0{\cdot}65 \times 10^6$ V/cm. C. B. A.

***1698. Stark Effect in Neon. W. Steubing and H. Kindler.** *Zeits. f. Physik,* 99. 1–2. *pp.* 103–108, 1936.—A water-cooled metallic discharge tube is described giving great luminosity. Using a stream of neon (99·5 % pure), exposures of 2 to 5 hr. with a prism spectrograph of 13 Å/mm. dispersion at 4100 Å, sufficed for the measurement of Stark effect in series numbers $2p_{10} - 6q$ and $2p_{10} - 7q$ which were hitherto unknown. F. S.

*1699. **Investigation of Raman Spectra with the Photoelectric Counter. V. Kudrjawzewa.** *Acta Physicochimica,* 3. 5. *pp.* 613–618, 1935. *In German.*—A photoelectric counter is put behind the second slit of a monochromator, and it is joined in the usual circuit with a ticking electrometer. From the number of ticks per minute for different settings of the monochromator, curves can be drawn giving directly the intensity of lines. The method is applied to investigate the anti-Stokes lines in the benzene spectrum. A. C. M.

1700. Raman Spectra of Ortho-Phosphoric Acid and Phosphates. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 3*A. pp.* 25–30, *Jan.,* 1936.—The Raman spectra of ortho-phosphoric acid for a wide range of concentrations and of the primary, secondary and tertiary phosphates of Na, K and NH_4 are obtained. The acid yields new lines which indicate the ionisation of $H_3PO_4 \rightarrow H^\circ + H_2PO_4'$ and the further ionisation of $H_2PO_4' \rightarrow H^\circ + HPO_4''$. Weak lines characteristic of the OH oscillations are also observed for the acid. The three series of phosphates give characteristic spectra which are identified as due to H_2PO_4', HPO_4'' and PO_4''' ions. The frequency shifts of the PO_4 radical are compared with those of SO_4 and SeO_4 and the force constants are evaluated. AUTHOR.

1701. Raman Effect of Solutions of Arsenic Halides. W. Finkelstein and P. Kurnossowa. *Acta Physicochimica,* 4. 1. *pp.* 123–134, 1936. *In German.*—Raman spectra are obtained for solutions of $AsCl_3$ and $AsBr_3$ in ether and in benzene. No lines are found which can be attributed to a complex of the halide with ether. It is concluded from this and from the results of conductivity and cryoscopic experiments that the solvate of $AsCl_3$ or $AsBr_3$ and ether is formed through interaction between the dipoles of the solvent and the ion-field of the arsenic, and not because of directed valencies. In both cases the frequencies observed are characteristic of undissociated $AsCl_3$ and $AsBr_3$ molecules. A. C. M.

1702. Raman Effect of Mixtures of Fuming Sulphuric Acid and Nitric Acid. J. Chédin. *Comptes Rendus,* 202. *pp.* 220–222, *Jan.* 20, 1936.—Raman spectra were recorded for various mixtures of fuming H_2SO_4 and 99 % HNO_3. Evidence is found of an association between N_2O_5 and SO_3, characterised spectrally by the frequency 1400 cm.$^{-1}$ of N_2O_5, the disappearance of the N_2O_5 line 1045 cm.$^{-1}$, the displacement of the SO_3 line 1070 cm.$^{-1}$. This association is quite different from that of SO_3 and H_2SO_4 in $H_2S_2O_7$, since in this latter case the mixture possesses a spectrum altogether different from the sum of those of its constituents.
A. C. M.

1703. Raman Spectra of Organic Liquids under High Dispersion and Resolving Power. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 3*A. pp.* 52–74, *Jan.,* 1936.—The Raman spectra of benzene, toluene, phenol, chlorbenzene, pyridine and cyclohexane are studied with a glass prism spectrograph with a resolution of 3 cm.$^{-1}$ and a dispersion of about 10 Å per mm. in the region investigated. Spectrograms are reproduced and measurements tabulated. The 992 cm.$^{-1}$ line of benzene is found to have four satellites in addition to the main line at 992·5 cm.$^{-1}$. The frequencies of these satellites are 979, 984, 998 and 1006 cm.$^{-1}$ and their respective intensities (relative to the main line, whose intensity is taken as 10) are estimated as $\frac{1}{4}$, 1, 1, $\frac{1}{4}$. The corresponding line of cyclohexane at 802 cm.$^{-1}$ shows no fine structure. The possibility of the 984 cm.$^{-1}$ line of benzene arising from the presence of the carbon isotope C^{13} is discussed

and several difficulties in the way of this view are pointed out. In the spectra of the monoderivatives and of pyridine the intense Raman line corresponding to symmetrical expansion and contraction of the nucleus is always accompanied by a faint companion on the short-wave side.
L. A. W.

1704. Raman Spectrum of Pyrrol Derivatives. G. B. Bonino and R. Manzoni-Ansidei. *Accad. Lincei. Atti*, 22. *pp.* 349–354, *Oct.*, 1935.—Continuing previous work the authors determined the Raman spectra of the following nitrogen substitution derivatives of pyrrol: N-ethylpyrrol, N-allylpyrrol, N-methyl-2-5-diethylpyrrol, N-ethyl-2-5-dimethylpyrrol; and of 2-5-dimethyl-3-ethylpyrrol. Raman lines associated with vibrations of the NH, CH, CH_2, and CH_3 groups are identified. Other lines due to vibrations of the pyrrol ring recur for the nitrogen derivatives as for other derivatives previously studied. Another line (1560–1600 $cm.^{-1}$) not observed with pyrrol itself but associated with double bonds in the ring, is found to occur as a weak line for one only of the nitrogen derivatives (N-methyl-2-5-diethylpyrrol). Increased probability of the appearance of this double bond line with increasing alkylation is thus exemplified for the nitrogen derivatives as for the carbon derivatives of pyrrol.
W. S. S.

1705. Raman Spectra and Constitution of Pyrazole and Derivatives. G. B. Bonino and R. Manzoni-Ansidei. *Accad. Lincei, Atti*, 22. *pp.* 438–443, *Nov.* 17, 1935.—Measurements of the Raman spectra of pyrazole, 3-5-dimethylpyrazole, 1-3-5-trimethylpyrazole, 1-3-4-5-tetramethylpyrazole and pyrazoline are reported. Nine lines, half of them weak, are referred to the pyrazole ring. The line characteristic of the double bond in the ring is absent for pyrazole as for pyrrol, thiophene and furfurane but appears for the more highly methylated derivatives named above. Evidence is obtained for a change in structure of the pyrazole ring in passing from pyrazole to its derivatives.
W. S. S.

1706. Raman Spectra of Dimethylfurazane and Dimethyloxibiazole. R. Manzoni-Ansidei. *Accad. Lincei, Atti*, 22. *pp.* 444–447, *Nov.* 17, 1935.—It is confirmed that, as found by Milone and Müller, the Raman spectrum of dimethyloxybiazole gives a sharp and intense double bond line which is absent for dimethylfurazane. The number of Raman lines associated with oscillations of the ring which were observed equalled 14 for the oxybiazole derivative and 15 for the furazane derivative, against the number 15 in each case predicted by Cabannes' theory for molecules of this symmetry character.
W. S. S.

1707. Raman Spectra of Aldehydic Pyrrol Substitution Derivatives. G. B. Bonino, R. Manzoni-Ansidei and D. Dinelli. *Accad. Lincei, Atti*, 22. *pp.* 448–452, *Nov.* 17, 1935.—The Raman spectra of 2, 4-dimethyl-5-formylpyrrol, 2, 3, 4-trimethyl-5-formylpyrrol, 2, 4-dimethyl-3-ethyl-5-formylpyrrol and 2-methyl-3,4-diethyl-5-formylpyrrol are described. In every case an intense diffuse line appears in the region 1620–1650 $cm.^{-1}$, which is referred to the group $C = O$. In addition it is shown that another line (1560–1570 $cm.^{-1}$) absent from the Raman spectrum of ordinary α-pyrrolaldehyde is emitted by the substitution derivatives. This line probably corresponds to a double linkage which can most plausibly be located in the nuclear ring.
W. S. S.

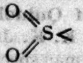
1708. Raman Spectra of Pyrrol and Derivatives. A. Stern and K. Thalmayer. *Zeits. f. phys. Chem.* 31. *Abt.B.* 6. *pp.* 403–419, 1936.—The Raman spectra of pyrrol and eight of its alkyl-substituted derivatives not previously studied are measured. The spectrum of pyrrol is found to contain frequencies attributable to $C = C$ and $C = N$ linkages and to the CH_2 group. From this it is deduced that a small proportion of the molecules must be present in the form in which the H atom usually regarded as attached to the N atom of the ring has migrated to a neighbouring C atom. The vibrations of the pyrrol model are discussed in the light of the Raman spectra of the alkyl derivatives investigated. L. A. W.

1709. Raman Spectra of Quinoline, Quinaldine, Isoquinoline and α- and β-Picolines. S. K. K. Jatkar. *Indian Journ. Phys.* 10. *pp.* 23–30, *Jan.*, 1936.—The Raman spectra of α- and β-picolines, quinoline, quinaldine and isoquinoline are studied. Evidence is found in support of the dual character of the fused ring systems in aromatic compounds as modified by the reactive methyl group. AUTHOR.

1710. Raman Spectra of Terpenes and Camphors. S. K. K. Jatkar and R. Padmanabhan. *Indian Journ. Phys.* 10. *pp.* 55–63, *Jan.*, 1936.—The marked differences in the Raman spectra of limonene and dipentene are shown to be due to different amounts of products of intramolecular isomerisation, namely, terpinolene and α-terpinene present in these compounds, the latter predominating in the technical dipentene. The difference in the spectra of fenchone and camphor is shown in the shifts 1412–1450 $cm.^{-1}$ due to the reactive CH_2CO group present in camphor. AUTHORS.

1711. Raman Spectra of Benzene and Derivatives. K. W. F. Kohlrausch. *Phys. Zeits.* 37. *pp.* 58–79, *Jan.* 15, 1936.—The data discussed are the frequencies of the Raman spectra, their polarisation states, and the results of model-experiments [see Abstract 3522 (1935)]. In section I are discussed the symmetry properties, vibrational modes, model- and Raman-spectra of unsaturated plane hexagonal rings (cyclohexatriene, cyclohexadiene, and cyclohexene). In section II a *resumé* is given of the symmetry properties and Raman-spectra of one to six-fold substitution products of benzene, and it is shown that by every criterion possible benzene must have six-fold symmetry. In section III an account is given of the quantitative description of the vibrations of C_6H_6 and C_6D_6. In sections IV, V, VI are discussed in detail the mono-, di-, and tri-derivatives respectively, and on the evidence of model experiments the frequencies of the derivatives are allocated to particular modes of vibration. In section VII reasons are given for considering the six-fold symmetry benzene ring to possess the characters of unsaturated C : C double bonds. A. C. M.

1712. Raman Effect of Cyclohexyl Derivatives and the Symmetry of the Cyclohexane and Dioxane Molecules. K. W. F. Kohlrausch and W. Stockmair. *Zeits. f. phys. Chem.* 31. *Abt.B.* 5. *pp.* 382–401, 1936.—The Raman spectra of cyclohexane, dioxane, piperidine and some mono-derivatives of cyclohexane (C_6H_{11} X with X = NH_2, OH, CH_3, CN, Cl, Br and I) are determined. The symmetry of the cyclohexane ring is discussed in the light of these observations, which are considered in relation to infra-red data and results upon the states of polarisation of the Raman lines of cyclohexane. Four models of the cyclohexane molecule are considered: the plane form, the "armchair" form, the "boat" form and a so-called "intermediate" form (respective symmetries D_{6h}, S_{6v}, C_{2v} and D_2). For none of these is the theoretically expected spectrum in complete agreement with the experimentally observed, the discrepancies being considered so serious as to exclude all but the "armchair" form, to which a certain probability of correctness is ascribed. The results for dioxane likewise exclude both the "boat" and "intermediate" forms. L. A. W.

1713. Raman Effect in Alkyl Sulphates. L. Médard and R. Marchand. *Comptes Rendus*, 202. *pp.* 320–321, *Jan.* 27, 1936.—The Raman spectra are photographed for $(CH_3)_2SO_4$ and $(C_2H_5)_2SO_4$. The values obtained are compared with those for H_2SO_4. Lines at about 400 cm.$^{-1}$ are attributed to the group  A. C. M.

1714. Raman Spectra of Octene-2 ol-1 and Derivatives. Blanche Gredy. *Comptes Rendus*, 202. *pp.* 322–323, *Jan.* 27, 1936.—The Raman spectra are described for octene-2 ol-1 $C_5H_{11}CH = CH \cdot CH_2OH$, and the acetate, bromide and methyl ether-oxide of the same compound (forms cis and trans). A. C. M.

1715. Raman Spectra of Cinnamic Derivatives (cis and trans). Blanche Gredy. *Comptes Rendus*, 202. *pp.* 664–666, *Feb.* 24, 1936.—Reports the Raman spectra of (cis and trans) cinnamic alcohol, acetate, methyl ether oxide, carbide and bromide. A. C. M.

1716. Raman Spectrum of Rubber and Related Hydrocarbons. S. D. Gehman and H. J. Osterhof. *Am. Chem. Soc., J.* 58. *pp.* 215–218, *Feb.*, 1936.—A Raman line spectrum has been secured for rubber and balata by using clear gels of the purified hydrocarbons. It was not found possible to eliminate the background entirely. The most intense frequency for both rubber and balata is the same, 1670 cm.$^{-1}$, ascribed to the double bond. Comparison of the frequencies for rubber and balata with those of trimethylethylene, myrcene, isoprene and limonene shows that the primary linkages in rubber are very similar to those in trimethylethylene, thus supporting the view that the rubber molecule consists of a long chain of isopentene units. Differences in the spectra require an explanation, however. The spectrum of balata shows differences from that of rubber such as might be expected from a cis-trans relationship. The spectrum of myrcene is largely a superposition of the isoprene and trimethylethylene spectra. AUTHORS.

1717. Raman Spectrum of Tetraethyl Silane. Vibrational Resonance of Tetraalkyls. T. F. Anderson. *J. Chem. Phys.* 4. *pp.* 161–164, *March*, 1936.—The Raman spectrum of tetraethyl silane is reported. Assignments of frequencies for this compound and for other tetraalkyls are made. An analysis of resonance between vibrations $\nu_1 + \nu_2$ and ν_3 explains the presence of extra lines which appear in the Raman spectra of each of these compounds. Resonance between frequencies $2\nu_2$ and ν_4 explains the presence of two additional lines observed in $Si(C_2H_5)_4$. Resonance between ethyl vibrations in $Si(C_2H_5)_4$ and in $Pb(C_2H_5)_4$ accounts for a split in the frequencies characteristic of the ethyl group. First-order perturbation calculations of the observed resonance effects are given in some detail. AUTHOR.

1718. Allocation of the Raman Frequencies below 1400 cm.$^{-1}$ of Organic Chain-Molecules to Longitudinal Vibrations. L. Simons. *Soc. Scien. Fennica, Comm. Phys.-Math.* 8. 16. [12 *pp.*], 1935.—The longitudinal vibrations of a straight row of mass-points with restoring forces between neighbours are investigated mathematically. Assuming the value 990 cm.$^{-1}$ for the C–C frequency of ethane, the longitudinal frequencies of longer carbon chains, assumed to be straight, are calculated and the results compared with experimental data. It transpires that 1400 cm.$^{-1}$ is the upper limit for frequencies of this type, and that there is considerable agreement between calculation and experiment, not only as regards the numbers of frequencies, but also in numerical values. The Placzek selection rules do not appear to be obeyed for the different symmetry classes of the longitudinal vibrations here considered. L. A. W.

1719. Wings and Rayleigh Lines in Liquid Mixtures. S. C. Sirkar. *Indian Journ. Phys.* 10. *pp.* 75–82, *Jan.*, 1936.—The wings accompanying the Rayleigh lines scattered in a mixture of 40 % benzene and 60 % cyclohexane, and in a 20 % benzene, 80 % methyl alcohol mixture, are compared with that due to pure benzene. Only a slight diminution in the intensity very near to the Rayleigh line and a slight increase at about 50 cm.$^{-1}$ is observed in the solution in cyclohexane. It is concluded that in benzene at any rate the origin of the wing is not lattice oscillations in quasi-crystalline groups. The wing is regarded as partly due to rotations, and partly to fluctuations of the intermolecular field. A. C. M.

1720. Raman Effect in Chemical Dynamics. W. F. Beezhold and L. S. Ornstein. *Physica*, 3. *pp.* 154–172, *March*, 1936.—The Raman spectrum of a transformer oil, before and after oxidation, shows a change in the intensity of the C–H lines. The photochemical chlorination of chloroform is followed completely by means of the Raman effect, using the intensity of the CCl_4 lines as a measure of the amount of CCl_4 present. A new way of illuminating a photochemical system is worked out, and experimental measurements and mathematical calculations concerning the light-absorption in such a system are in agreement. Simple but accurate measurements with a selenium photo-cell confirm the Raman spectrum results. A theoretical interpretation of the empirical reaction equation is given. It is maintained that highly unstable chain products can be detected by means of the Raman effect. A. C. M.

∗1721. Energy Balance in Monochromators. M. Berek. *Zeits f. Instrumentenk.* 56. *pp.* 109–115, *March*, 1936.—The conditions necessary for the production of maximum intensity of monochromatic light in any given part of the spectrum by means of a monochromator are investigated. It is shown that the efficiency of the monochromator depends not on its aperture (provided this is rationally chosen), but essentially on the prism, in particular on the cross-section of this perpendicular to the light path, its absorption, refraction and dispersion. C. B. A.

1722. Nitrogen Atom and Molecule. L. S. Mathur and P. K. Sen-Gupta. *Acad. Sci., Proc., U.P., India*, 5. *pp.* 187–226, *Dec.*, 1935.—All recent work on the various systems of bands is reviewed in detail.
A. H.

1723. Effect of Evaporated Films on Energy Distribution in Grating Spectra. J. Strong. *Phys. Rev.* 49. *pp.* 291–296, *Feb.* 15, 1936.—It is found that Wood anomalies of intensity distribution in grating spectra are frequently developed by coating the grating with an evaporated film of Mg, Ag or Al. It is observed that the effect is best exhibited by gratings with very narrow fine ruling. The typical band illustrating the phenomenon is a double band—a dark band in juxtaposition to, and on the red side of a bright band. The dark band is characterised by a sharp boundary on the blue side. The Rayleigh formula which predicts the position of these anomalies in the spectrum is found to hold for the measurements on this sharp boundary. An empirical relation of similar form is developed from measurements on the bright bands. Other general observations on the bands are recorded. AUTHOR.

1724. Quantitative Spectral Analysis under Variable Discharge Conditions. W. Naedler. *Comptes Rendus (Doklady) de l'Acad. des Sciences,* 4. 1–2. *pp.* 23–26, 1935. *In German.*—Gerlach's method of quantitative determination of the concentration of an admixed substance z relative to a main substance g consists in comparing the intensities of an homologous pair of lines of z and g under conditions in which the intensities I_1 and I_2 of a reference pair of lines of g are equal. The reference pair is used to prevent errors arising due to changes in discharge conditions but is of only limited effective application. It is now found that there is a dependence between the intensity ratio of lines of z and g and the intensity ratio of the reference pair, *i.e.* $Iz/Ig = fI_1/I_2$. The function fI_1/I_2 can be determined by controlled variation of the concentration of z with respect to g. The relation can then be used as the basis of an accurate quantitative analytical method applicable under very variable discharge conditions and in cases in which the measured lines of z and g are not strictly homologous. An example is given of the application of the method to the determination of Pt and Rh in Ag. J. E. K.

1725. Spectroscopic Estimation of Adsorbed Ions. May Annetts and L. Newman. *J. Phys. Chem.* 40. *pp.* 187–193, *Feb.,* 1936.—Emission spectrum analysis is applied to the estimation of ions in colloidal solutions, the uncondensed spark method being used. The method of analysis being suitable for use with metallic ions only, the experiments are confined to salts containing metals in both ions. The limiting sensitivities attained are *M*/100,000 for Au and Mn; *M*/50,000 for Mg, Cr and Na; *M*/1000 for Al. A. H.

See also Abstracts **1427, 1494, 1590, 1596, 1597, 1600, 1601, 1621, 1636, 1647, 1648, 1770, 1795, 1796, 1797, 1815.**

VISION.

1726. Vision in Directed Light. Y. le Grand. *Comptes Rendus,* 202, *pp.* 592–594, *Feb.* 17, 1936.—The author has previously described a method for determining the visual acuity associated with retinal structure excluding effects due to the imperfections of the optic media of the eye [see Abstract 2148 (1935)]. A simpler method with somewhat the same object is here discussed. Using Maxwellian view, a good objective lens is employed to focus an image of a very small light source in the pupillary plane of the subject. The distance apart at which two fine wires stretched across the lens can just be separated determines the acuity. Since the eye pupil collects the diffraction pattern of the point source, image formation on the retina should be perfectly sharp provided the tract of optic media through which the ray pencil passes is of "good quality." Exploring different points of entry in the pupil, it is found that a few give excellent image formation, most positions leading to obscuration of the contrast. Data showing the greater acuity obtainable, especially at low brightnesses, by the use of directed light compared with normal vision are reported.

W. S. S.

X-RAYS.

***1727. Mercury Switches. G. Mönch.** *Zeits. f. techn. Physik,* 17. 2. *p.* 61, 1936.—A description is given of a mercury switch which is used to safeguard hot-kathode X-ray tubes against failure of the cooling water, the switch being operated by a change in pressure of the water supply and used to either disconnect the apparatus or give an alarm signal. There are two types of switch, both being U-tubes about half filled with mercury, with one limb open to the atmosphere and the other connected with the water supply. The tubes are made of glass and one electrode is taken through the glass to make contact with the mercury at the bottom of the U. In one type of switch the second electrode is led up through an insulated tube to be exposed at a point just below the normal mercury level in the limb connected with the water supply. In the other type the second electrode is taken down from the top of the limb open to the atmosphere and is set at a height just above the normal mercury surface, the position being adjustable. In the first type, when the water supply is on, the mercury is depressed in the water supply limb and the circuit is broken, whilst, in the second, the level is raised on the atmospheric side and the circuit completed. A. C. W.

***1728. Rediffusion of High Speed Electrons in Narrow Tubes. F. Oswald.** *Zeits. f. techn. Physik*, 17. 2. *pp.* 41–44, 1936.—An arrangement is described for observing the scattering (by reflection) of X-rays by the walls of a narrow tube. Kathode rays, derived from a hot source, pass through a narrow slit and then through a long narrow tube drilled in the anode, at the end of which they impinge on the anode block at an angular incidence of 45°. The X-rays generated are allowed to act upon a photographic plate, placed parallel to the tube axis, after transmission through a pinhole camera. The images show a fairly sharply defined focal spot with 2 dark tails (due to secondary electrons). The diameter of the focal spot is slightly smaller than the diameter of the tube. The focus is only sharply defined in an axial direction if the diameter of the kathode ray bundle is approximately the same as the diameter of the tube; in a direction at right angles the effects of secondary electrons become marked. H. J. H. S.

1729. X-Ray Emission and Absorption Measurements. H. Küstner and E. Arends. *Ann. d. Physik*, 25. 5. *pp.* 385–412, *March*, 1936.—The accuracy of previous measurements [see Abstract 2607 (1935)] made by the authors on the fluorescent yield for the K- and L-series of various elements, and on absorption and intensity, has been questioned by Schwarz [see Abstract 4299 (1935)]. The authors refute Schwarz's assertions and describe in detail the methods by which their results are obtained. They, in turn, criticise certain of Schwarz's results. J. T.

1730. Al Kβ-Bands from Al-Cu Alloys. S. Yoshida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 617. *pp.* 243–248, *Feb.*, 1936. *In English.*—The forms are studied of the Al Kβ-bands from targets of pure Al and Al-Cu alloys with various proportions. The shape and width of the band from the pure Al target agree well with those calculated from the perfectly free electron model. The band from the alloy target, when the content of Al decreases, separates into two, which overlap each other, and one of lower energy becomes strong in intensity. A possible interpretation for these phenomena is described. AUTHOR.

1731. K-Emission Lines of Elements Cr to Cu. M. Privault. *Ann. de Physique*, 5. *pp.* 280–324, *Feb.*, 1936.—The paper contains descriptions of X-ray tubes in which the iron anti-kathodes are magnetised to saturation point, to above the Curie point, and to above the γ point. No modification of radiation is detected. The best types of spectrograph are discussed. The X-ray fluorescence spectra of Fe, Cr and Mn compounds are studied. W. R. A.

1732. Width of the Kα_1 Line of Molybdenum. J. Weigle. *Comptes Rendus*, 202. *pp*. 564–566, *Feb*. 17, 1936.—Using a Cauchois type spectrograph with curved mica crystal, preliminary measurements are described which give the value $0 \cdot 190 \pm 0 \cdot 005$ Å for the width at half-intensity maximum of the MoKα_1 line; this is smaller than that obtained by other investigators by the double crystal spectrometer. N. M. B.

1733. Absorption Edges of Ultra-Soft X-Rays from the Emulsion of Photographic Plates and from Sensitisers. J. M. Bačkovský and V. Dolejšek. *Zeits. f. Physik*, 99. 1–2. *pp*. 42–51, 1936.—Using a low-voltage ionic tube, reversed absorption edges ($L_{II\text{-}III}$) are observed for potassium, chlorine and calcium, as well as the $M_{IV\text{-}V}$ edges for silver and bromine. The differences between the calculated values for the $M_{IV\text{-}V}$ edges of silver are discussed. Confirmation is obtained of the existence of the normal $L_{II\text{-}III}$ absorption edge of SiO_2, as found by Siegbahn and Magnusson [see Abstract 2927 (1934)] with a glass grating. L. A. W.

1734. Interference of X-Rays. E. Lohr. *Ann. d. Physik*, 25. 3. *pp*. 205–208, *Feb*., 1936.—Kohler [see Abstract 5351 (1933)] used wave-mechanical methods to obtain equations of propagations of X-rays in crystals. The object of the author's paper is to show that equations identical with those of Kohler can be derived from the author's earlier calculations which are based on the concept of the Jaumann continuum. J. E. R. C.

1735. Interpretation of the X-Ray Diffraction Pattern of Liquid Carbon Tetrachloride. I. Nitta and T. Watanabé. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No*. 620. *pp*. 277–283, *Feb*., 1936. *In English*.—Diffraction photographs of liquid CCl_4 are obtained by the transmission method, the results being in general agreement with those of Pierce and of Menke [see Abstract 5057 (1932)]. A minimum is observed in the intensity curve at about $\sin\theta/\lambda = 0 \cdot 21$ with adjacent maxima at $0 \cdot 17$ and $0 \cdot 25$, while Menke's theoretical curve shows only a maximum at $0 \cdot 21$ between minima at $0 \cdot 11$ and $0 \cdot 33$. From a consideration of van der Waals forces, and assuming a distance of closest approach of Cl atoms in neighbouring molecules to be $3 \cdot 90$ Å, Menke's theory is modified to explain the observed maxima. The existence of molecular association is shown to be essential for the interpretation of the observed diffraction pattern, and further, it is concluded that the fraction of associated molecules in the liquid is high. C. J. B. C.

1736. Quantitative Measurement of X-Ray Reflections from Microcrystalline Plates. J. Brentano. *Zeits. f. Physik*, 99. 1–2. *pp*. 65–72, 1936.—The paper is an addition to recently published work by the author on this subject. Several questions not discussed in his previous work are dealt with here. A substitution method for obtaining quantitative measurements of the intensity of X-ray reflection is described and compared with the method of mixed powders previously given. The significance of the variation in background intensity is discussed in relation to the evaluation of the intensity of reflection. J. T.

1737. X-Ray Diffraction with Calcite in Several Orders of Reflection. L. G. Parratt and F. Miller, Jr. *Phys. Rev*. 49. *pp*. 280–288, *Feb*. 15, 1936.—Theoretical and experimental values of the four properties of reflection (width of the $(n, -n)$ rocking curve, per cent reflection, coefficient of reflection and a factor determined by the shape of the $(n, -n)$ curve) of calcite crystals are compared throughout the wave-length ranges $0\cdot71 < \lambda < 5\cdot83$ Å in first order, $0\cdot71 < \lambda < 2\cdot75$ Å in second order, and with wave-lengths 0·71 and 1·54 Å in third order and 0·71 Å in fourth and fifth orders. The Darwin-Ewald-Prins theory is evaluated with an attempt to correct (1) for the effects of the thermal motions of the atoms in the crystal and (2) for the variation of the atomic structure factor of Ca in the wave-length region of anomalous dispersion. Excellent qualitative agreement is found but general quantitative agreement is not found. The concept of mosaic structure in the crystal lattice is not entirely sufficient to account for the discrepancies. AUTHOR.

1738. Diffraction of X-Rays by Diamond. P. P. Ewald and H. Hönl. *Ann. d. Physik*, 25. 4. *pp.* 281–308, *Feb.*, 1936.—The diffraction of X-rays by diamond is considered from the point of view of wave-mechanics and the existence of the " forbidden " (222) reflection is explained. Owing to difficulties arising from the use of the many-dimensional Schrödinger-space in the treatment of the problem of a three-dimensional lattice, which are not allowed for in the present paper, the calculated intensity of the (222) reflection is far below that observed in practice. J. T.

***1739. X-Ray Diffraction Apparatus. A. Karsten.** *Zeits. f. Instrumentenk.* 56. *pp.* 120–123, *March*, 1936.—A description is given of a few recently produced commercial X-ray diffraction outfits designed for routine use in industry and made by Siemens. J. T.

1740. Wave-Length of L-Series of Elements Cu29 to Fe26. F. Tyrén. *Zeits. f. Physik*, 98. 11–12. *pp.* 768–774, 1936.—The determinations of the X-ray wave-lengths are made with a concave grating of 5 m. radius of curvature, and employing a glancing angle of 1°. The reference lines are H-like optical lines photographed on the same plate. Data for the L-series of Cu, Ni, Co and Fe are reported. W. S. S.

See also Abstracts 1437, 1438.

HEAT.

CALORIMETRY.

1741. Atomic Heat of Nickel at Low Temperatures. K. Clusius and J. Goldmann. *Zeits. f. phys. Chem.* 31. *Abt.B.* 4. *pp.* 256–262, 1936.—Measurements on the atomic heat of Ni are carried out between 10° and 30° Abs. The authors find, in agreement with Keesom and Clark, that Ni shows an anomalous fall in atomic heat, which cannot, however, be determined either by the Bloch $T^{3/2}$ law for ferromagnetism or in accordance with the Sommerfeld T law for free electrons. J. K.

1742. Molar Heats of Gases at Low Temperatures by the Thermal Conductivity Method. A. Eucken and A. Bertram. *Zeits. f. phys. Chem.* 31. *Abt.B.* 5. *pp.* 361–381, 1936.—The method of Eucken and Weigert [see Abstract 242 (1934)] is used in the determination of the thermal conductivities of a number of gases relative to argon. With polyatomic gases whose normal oscillations and hence whose molar heats are known the results show that, for the oxidised nickel filament used, the so-called accommodation coefficient (a factor occurring in the equation connecting thermal conductivity and molar heat) usually assumes the value unity at low temperatures. This makes it possible to deduce the molar heats of other gases (SeF_6, TeF_6, CF_2Cl_2, C_2H_2, C_2N_2, CF_4) from thermal conductivity measurements at these temperatures and hence to test and supplement the determinations of normal oscillation frequencies by optical methods. The accommodation coefficients deviate from the value unity at higher temperatures and a simple formula is deduced which expresses these deviations as deduced from conductivity measurements. L. A. W.

See also Abstract 1447.

CONDUCTION.

1743. Distribution of Temperature in a Cylindrical Conductor Electrically Heated in Vacuo. H. G. Baerwald. *Phil. Mag.* 21. *pp.* 641–658, *March*, 1936.—The temperature distribution in cylindrical conductors electrically heated *in vacuo* is investigated. It is shown that the transversal variations are negligible. A simple method is given for deriving the longitudinal temperature distribution directly from the empirical data of the emissivity, thermal and electrical conductivity functions. If the conductor can be regarded as "infinite," for which a criterion is given, the dependence of the temperature gradient on temperature is given at once in terms of functions which are known for every metal for which measurements exist. This is of importance for the design of cooling devices for thermionic valves. The temperature distribution itself is obtained simply by integration. If the conductor is not "infinite," the determination of a constant is necessary; it is shown, for different end conditions, how it can be obtained conveniently. AUTHOR.

See also Abstract 1742.

CONVECTION.

1744. Heat Transfer Due to Rapid Gas Flow in Straight Tubes. A. Guchmann, N. Iljuchin, W. Tarassowa and G. Warschawski. *Techn. Phys., U.S.S.R.* 2. 5. *pp.* 375–413, 1935. *In German.*—A theoretical and experimental study is made of the heat transfers which accompany the rapid flow of gases through tubes. In addition to the usual equation indicated by hydrodynamical theory, $Nu/Pe = \zeta/8$, where ζ is the resistance coefficient, the heat transfer is shown to be given by the following dimensionless groups :—$Nu = \phi(v\tau/d$, Re, Ba, $\Delta T/T$, L_1/d, $L_2/d)$; v being the velocity, τ the time, d the diameter, ΔT the temperature difference in the entrance cross-section, T the tube temperature, L_1 and L_2 the lengths of the initial and final sections, and Ba the ratio of the gas velocity to the velocity of sound. The experiments show that up to values of Ba of approximately 0·95, $Nu = 0{\cdot}017\ Pe^{0{\cdot}82}$. This result shows that the compressibility of the gas has but little influence on the heat interchange between the gas and the tube. R. W. P.

1745. Thermal Scale of Turbulence. L. Loitzianski and B. Schwab. *Techn. Phys., U.S.S.R.* **2**. **5**. *pp.* 414–430, 1935. *In English.*—The degree of turbulence of an air stream has been stated by Dryden and Kuethe to be given by $\sqrt{\bar{u}^2}/V$, the ratio of the r.m.s. of the deviations of the velocity from its mean value to the mean velocity. These workers suggested a scale of turbulence based on the observation of the critical Reynolds number, Re_c, at which the coefficient of resistance of a sphere falls to a value of 0·3. It is pointed out that this method has disadvantages in that as Re_c lies between 10^5 and $3{\cdot}5 \times 10^5$, either the velocity has to be high or the sphere must be of large diameter d, also Re_c is a function of d. The authors seek to determine a scale of turbulence depending on measurements of the heat transfer from a sphere. Measurements of the coefficient of resistance and the heat transfer are made over the range of values of Re from $0{\cdot}3 \times 10^5$ to 3×10^5 using spheres of 7 and 15 cm. dia. In the heat transfer experiments arrangements are made to maintain the sphere at an approximately constant temperature by means of boiling water. The actual degree of turbulence is derived by comparing the resistance data with the results of Dryden and Kuethe, and their values for $\sqrt{\bar{u}^2}/V$, and it is found that the curves obtained by using the heat transfer data and plotting Nu against Re depend quite definitely upon the degree of turbulence even at the lowest value of Re used. Varying the diameter of the sphere still affects the curve $Nu = f(Re)$, but the advantage of the proposed method is that a specific value of Re is no longer necessary, and one sphere may be used to determine the turbulence in all cases. In these experiments the 7 cm. dia. gave satisfactory results, and future experiments are to be directed towards the use of still smaller spheres. R. W. P.

1746. Heating of a Body in a Rapid Air Current. E. Brun and R. Lecardonnel. *Comptes Rendus*, **202**. *pp.* 555–556, *Feb.* 17, 1936.—The use of an antifrosting arrangement on the antenna of a Badin deflector led to a study of the heating of the antenna in an air current passing through a pipe. The antenna is placed along the axis of the pipe. A manganin-constantan thermocouple has one joint embedded in the wall of the tube without changing its smooth surface. As the air speed (v) increases the fall of temperature (θ) is given by the parabolic relation, $\theta = 0{\cdot}8 \times 10^{-4}v^2(m/s)$. For the expansion of air in bellows St. Venant's formula gives for the cooling $\theta' = 5{\cdot}0 \times 10^{-4}v^2$. The difference $4{\cdot}2 \times 10^{-4}v^2$ represents the heating of the body due to friction of the air and it is found to hold up to the speeds tested. R. S. R.

1747. Theory of Bénard's Cellular Vortices. P. Vernotte. *Comptes Rendus*, 202. *pp*. 119–121, *Jan*. 13, 1936.—The bearing of the theory proposed by Rayleigh, to explain the formation of cellular vortices in a layer of liquid uniformly heated from below, on Bénard's early experiments using spermaceti is discussed. Whereas the original theory only agreed with these results as regards the size of the vortices, it is now shown that, by making a suitable modification of the equation of convection, agreement can also be reached as regards the limits of stability of the vortices. R. W. P.

See also Abstracts 1630, 1743.

DILATATION.

See Abstract 1411.

MELTING AND BOILING POINTS.

1748. Liquid State and Interatomic Forces. S. Franchetti. *Accad. Lincei, Atti*, 22. *pp*. 433–438, *Nov*. 17, 1935.—The author considers theoretically the relations between potential energy and interatomic forces in the transition of a homopolar crystal lattice to the liquid state. It is concluded that although in the liquid the interatomic distance is approximately equal to the distance from the atom at which the interatomic force curve has its minimum, fusion of the solid will occur when the interatomic distance attains a value which is somewhat smaller than that in the liquid. On these lines an explanation of volume change in fusion is possible. Extension of the theory to the transition liquid-gas is touched upon. W. S. S.

1749. Liquid State and the Theory of Fusion. Parts I and II. J. Frenkel. *Acta Physicochimica*, 3. 5. *pp*. 633–648, *and* 3. 6. *pp*. 913–938, 1935. *In English*.—The arguments presented in Part I show that the relation between the solid (crystalline) and the liquid state is more one of likeness than of contrast. The various sections of the paper deal with translatory motion in liquids, rotation of liquid molecules, and destruction of regularity with increase of volume. It is shown that, unless the temperature is too low, the crystal lattice will become practically amorphous without breaking up as a whole, *i.e.*, transformed into a liquid or amorphous solid by the application of a moderate negative pressure lying below the tensile strength limit. The increase of the volume on the degree of regularity is reduced thermodynamically to the decrease of the dissociation energy. Part II continues the investigation and deals with the theory of fusion and crystallisation. The various sections of the paper consider the (p, v) isotherm for the condensed phase. the approximate theory of equilibrium between crystal and liquid, the (p, v) isotherm of a crystal, and the relation between the solid, liquid and gaseous states. It appears to be indicated that a critical temperature for fusion exists, quite similar to that for boiling (or condensation) and differing from it only by the fact that it is not the highest temperature below which the body can split up into two different phases (liquid and gaseous) but the lowest temperature above which such a splitting (into the crystalline and the amorphous phases) can possibly take place. The paper concludes with a discussion of the instability of some of the states of the virtually continuous sequence leading from the crystal to the liquid, and of the formation of the crystallisation nuclei in a supercooled liquid. H. H. Ho.

1750. Quantum Statistical Theory of Fusion. L. Tarschisch. *Zeits. f. Physik*, 99. 3–4. *pp.* 259–273, 1936.—In this mathematical paper a theory of fusion is developed which is based on the Debye quantum theory of specific heat and the Born theory of the dynamics of the crystal lattice, and utilises the recent Fermi-Debye statistical methods. H. H. Ho.

1751. Copper-Tin Alloys. W. Broniewski, J. T. Jablonski and S. Maj. *Comptes Rendus*, 202. *pp.* 305–307, *Jan.* 27, 1935.—A study is made of the Cu-Sn system. Particular attention is paid to the compounds Cu_4Sn, Cu_3Sn and Cu_3Sn_2. J. T.

1752. Influence of Supersonic Waves on the Solidification of Metals. S. Sokoloff. *Acta Physicochimica*, 3. 6. *pp.* 939–944, 1936. *In French.*—The metal (Zn, Sn, or Al) is cast into a crucible maintained electrically at 700° C.–800° C. and cooled slowly. By means of a 5–6 kW valve generator and a Langevin quartz-ring oscillator of 20 cm. dia. and 0·5 cm. thickness, mounted between two massive steel armatures, about 80 W is transmitted to the metal ($n = 6 \times 10^5$ to $4{\cdot}5 \times 10^6$). To minimise absorption by the porous refractory it may either be mounted directly on the oscillator, or a specially shaped steel crucible with broad conical base may be used. Absorption of heat by the latter also prevents too high a rise in temperature with consequent charring of the oil medium through which the oscillations are conveyed to the crucible. While the oscillator is in operation, the liquid metal surface becomes agitated and the rate of solidification is appreciably accelerated. Cooling curves show irregularities and a definite slight depression of freezing point. From micrographic evidence it is suggested that dendritic structure is accentuated. D. R. H.

1753. Thomson's Theory of Condensation on Ions. E. Hückel. *Phys. Zeits.* 37. *pp.* 137–138, *Feb.* 15, 1936.—In the derivation of Thomson's formula for the vapour pressure of a charged drop it is assumed that the charge is uniformly distributed over the surface. For the case of condensation on an ion or electron the charge is concentrated at the centre. This case is solved and shown to lead to

$$\log p'/p_0 = v''/\mathrm{RT}[2\sigma/r - e^2/8\pi r^4(1/\mathrm{D}' - 1/\mathrm{D}'') + (p' - p_0)].$$

Except near the critical point the last term can be neglected and the equation then reduces to that of Thomson when $\mathrm{D}'' \to \infty$. (p' = vapour pressure of sphere of radius r, p_0 = the vapour pressure of a plane uncharged surface, v'' = molecular volume of the liquid, σ = surface tension, e = charge, R = gas constant, T = absolute temperature, D′ and D″ = dielectric constants of vapour and liquid respectively). R. W. P.

***1754. Electrically-Heated Melting Point Apparatus. E. Dowzard and M. J. Russo.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 74–75, *Jan.* 15, 1936.—A simple electrically heated air-bath is described and illustrated, which can be used for the determination of melting points up to 310° C. The results are considered to be reproducible to within 0·5° C., and to agree well with those obtained with large mechanically stirred liquid-baths. R. W. P.

TEMPERATURE, MEASUREMENT OF.

***1755. Calibration of Platinum Thermometers at the Boiling Point of Sulphur. C. D. Niven.** *Canad. J. of Research*, 14. *Sect. A.* *pp.* 1–15, *Jan.*, 1936.—A description is given of the means by which certain difficulties in experimental technique can be overcome. The construction and starting up of the apparatus in such a way as to avoid breakage of the boiling tube is described, and also the making and suspension of the radiation shield, and the general operation of the apparatus. The calculation of the resistance at 444·6° C. is discussed. Geometrical proofs are given for the relations from which the resistance at 100 and 444·6° C. are calculated, and special emphasis is laid upon the difference between the two formulæ. The effect of errors in readings on the evaluation of δ are computed for a 10 ohm and a 32 ohm thermometer, and are shown diagrammatically. It is pointed out that errors in measurements of resistance at the steam point and the ice point are of far greater importance than errors in the measurements at the boiling point of sulphur. The conclusion is reached that the present equipment is not accurate beyond the third decimal place in the value of δ. AUTHOR.

See also Abstracts 1763, 1764, 1795, 1845.

THERMOCHEMISTRY.

1756. Heat Content of Sodium Chloride in Extremely Dilute Aqueous Solutions. T. F. Young and W. L. Groenier. *Am. Chem. Soc., J.* 58. *pp.* 187–191, *Feb.* 6, 1936.—The chord-area method of Young and Vogel is applied to the recent heat of dilution measurements of Gulbransen and Robinson [see Abstract 1195 (1935)]. Values of S^0, the limit (as $m \doteq 0$) of the derivative of the apparent molal heat content with respect to the square root of the molality, are found to be from 14 to 50 % greater than indicated by the preliminary calculations of Gulbransen and Robinson. The new S^0 values are in satisfactory agreement (0 to 5 %) with limiting slopes calculated from the Debye-Hückel theory and Wyman's dielectric constant data. AUTHORS.

1757. Heat of Combustion and Refraction Data of Crotonic Acid Esters. E. Schjånberg. *Zeits. f. phys. Chem.* 175. *Abt.A.* 5. *pp.* 342–346, 1936.—The energy of splitting and the so-called refraction and dispersion increments of the (C = C) — bond are evaluated. The influence of structure is shown. The increment is found to be much greater than according to the calculations based on Eisenlohr's atomic constants. J. K.

1758. Heat of Formation of Iron Nitrides. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 619. *pp.* 271–276, *Feb.*, 1936. *In English.*—By using the observed specific-heat data of Fe_4N and Fe_2N, the heats of formation of Fe_4N and Fe_2N are computed by means of the Nernst's heat theorem from the observed equilibrium constants of the systems $Fe–NH_3–Fe_4N–H_2$ and $Fe_4N–NH_3–Fe_2N–H_2$ at high temperatures. When compared with those obtained by calorimetric measurements agreement is satisfactory. AUTHOR.

1759. Detonation Limits and Velocities of Gaseous Mixtures. J. Breton and P. Laffitte. *Comptes Rendus*, 202. *pp.* 316–318, *Jan.* 27, 1936.—In the same way the percentage of combustible at the lower (L*i*) and upper (L*s*) limits of detonation, and the maximum (VM) and minimum (V*m*) velocities (m./sec.) of the explosion wave with the percentage of combustible in various mixtures, have been determined: $C_3H_8–O_2$, L*i* 3·1–3·2, L*s* 36·9–37, VM 2648 (31 % C_3H_8); $C_4H_{10}–O_2$, L*i* 2·8–2·9, L*s* 31·3–31·4, VM 2600 (22); $C_2H_2–O_2$, L*i* 3·5–3·6, L*s* 92–93, VM 2950 (50), V*m* 1923 (99); C_2H_2-air, L*i* 4·0–4·2, L*s* 50–51, VM 2011 (15), V*m* 1722 (35); $NH_3–O_2$, L*i* 25·0–25·4, L*s* 75·4–76, $Et_2O–O_2$, L*i* 2·6–2·7, Ls > equilibrium vapour pressure; Et_2O-air, Li 2·7–2·8, Ls 4·5–4·6, VM 1780 (4·1). Increase in pressure widens the limits of detonation, thus with H_2–O_2 under one atmosphere Li and Ls are 15 and 90–90·4, and under 8·7 atmospheres 13·9–14·3 and 91·1–91·3 respectively, and for H_2-air Li is similarly lowered from 18·5–18·8 to 14·8–15·1. Addition of small quantities of H_2 lowers Li for mixtures of CO–O_2 considerably. [See Abstract 3819 (1934).] C. A. S.

1760. Explosion Oxidation of Methane. N. Koboseff, J. Kasarnowsky and L. Kaschtanoff. *Acta Physicochimica*, 3. 6. *pp.* 857–878, 1936. *In German.*—The mechanism of CH_4 oxidation which ensues during the explosion of equimolecular mixtures of CH_4 and O_2 is investigated. The experiments are carried out in a bomb of the Berthelot type by means of a glowing tungsten wire. The initial and final pressures in the bomb are measured by a mercury manometer valid up to 4 atmospheres, and the resultant gases CO_2, O_2, C_2H_2, C_2H_4 and CO are analysed by the Hempel method. The influences of the following factors upon the explosion results are studied: pressure, the content in the initial mixture of CH_4, O_2, N_2, CO_2, CO, H_2 and H_2O, and the diameter and condition of the walls of the explosion vessel. It is found that the final state of the system can be established entirely from thermodynamical equilibrium conditions. The reaction gives mainly CO and H_2, and provides a simple and cheap process for the manufacture of H_2 or of a mixture of N_2 and H_2. H. H. Ho.

1761. Influence of Pressure on the Spontaneous Ignition of Inflammable Gas-Air Mixtures. Part IV. D. T. A. Townend and E. A. C. Chamberlain. *Roy. Soc., Proc.* 154*A*. *pp.* 95–112, *March* 2, 1936.—Previous investigations [see Abstract 3820 (1934)] into the influence of pressure on the spontaneous ignition of butane, *iso*-butane, pentane, and hexane-air mixtures are extended to the lower paraffins methane, ethane, and propane. Whereas with the higher paraffins the ignition points are found to lie in two well-defined temperature ranges. With methane or the intermediate products to which it gives rise, they are confined to an upper range even at pressures up to 30 atmospheres. With ethane-air mixtures a lower temperature ignition system develops at pressures above 13 atmospheres; the presence of 1 % of acetaldehyde in the medium, however, reduces this to below 5 atmospheres. Propane-air mixtures reveal all the ignition characteristics of the higher paraffins, ignition in the lower system being greatly facilitated by the presence of small amounts of either prop- or acet-aldehyde. The influence of pressure on the pre-ignition time-lags is also investigated, the *iso*-lag curves for lags of less than 2 sec. exhibiting a marked pressure minimum at about 410° C., an observation of importance in regard to "knock." The previous view that ignition in the lower system occurs when temperature and pressure conditions favour the survival and further oxidation of aldehydes is now supported by fresh evidence. H. H. Ho.

1762. Hydrogen Effect in Certain Oxides. E. L. Nichols and C. L. Stanford. *J.O.S.A.* 26. *pp.* 91–98, *Feb.*, 1936.—The glowing of finely divided metals and oxides in H_2 is reviewed historically. Black PrO_2 heated to about 1000° is subjected, at various stages of cooling, to the action of a jet of H_2; in each case the temperature rose by about 80° to 200°. Similar results were given by CeO_2 and Gd_2O_3; the grey oxide Pr_2O_3 is inert to H_2, but on heating reverts to the black form. Results show that these rare-earth oxides, even when not in solid solution, show the hydrogen effect. It is found, also, that free O_2 is necessary for the heating effect to take place. The activity of different oxides is compared in a series of normal heating curves for MgO, CaO, La_2O_3, Cb_2O_3, Al_2O_3, SiO_2, Gd_2O_3, and Nd_2O_3 under certain specified conditions. Departure from these conditions results in abnormal curves which are given and discussed. N. M. B.

See also Abstracts **1428, 1506, 1664, 1692, 1800.**

THERMODYNAMICS.

1763. Critical Temperatures of Deuterium Compounds. H. Kopper. *Zeits. f. phys. Chem.* **175.** *Abt.A.* **6.** ***pp.*** **469–472, 1936.**—The critical temperatures of DCl, DBr, DI, D_2S, D_2Se, D_3N, D_3P and D_3As and of the normal hydrogen compounds are measured. The values for the latter are higher than those for the analogous deuterium compounds, the difference ranging from 0·2° C., for D_3N and NH_3 to 2·1° C. for DI and HI. R. W. P.

1764. Data of State of Phosphine at Low Pressures and from 190 to 300° Abs. E. A. Long and E. A. Gulbransen.** *Am. Chem. Soc., J.* **58.** ***pp. **203–205,** ***Feb.*****, 1936.**—A "double" constant volume gas thermometer is described for measuring the low pressure data of state of gases at low temperatures. The method consists of a direct comparison of the properties of the gas in question with the known P.V.T. behaviour of He. Data of state are determined for pure PH_3 from 190 to 300° K., and the experimental values of the second virial coefficient B were calculated over this temperature range. The dependence of the virial coefficient B on temperature is well represented by a power series in $1/T$. The accuracy is about 3 units in B, corresponding to 0·005 cm. in measured pressure. The variation of the virial coefficient with temperature is shown graphically. Comparison is also made with the virial coefficients computed from Berthelot's equation, which proves to be fairly accurate both in reproducing the molal volumes and the slope of the B-T curve. AUTHOR.

1765. Extreme Values of the Joule-Thomson Effect. W. Jacyna. *Zeits. f. Physik,* **98. 11–12.** ***pp.*** **775–789. 1936.**—This paper mainly examines second order effects, *viz.*, (1) the Jakob-Planck form of the equation of state, (2) determination of volume deviations, (3) limiting value of the Joule-Thomson effect at $p = 0$, (4) particular case of positive values of the Joule-Thomson effect, (5) general relationships, (6) extreme values of the Joule-Thomson effect upon μ_f-isobars, (7) μ_f-isotherms, (8) application of the inversion line, (9) experimental proof of the theory based on data for oxygen and air. In general, the consideration of the experimental data shows that deviations on the classical theory, which are not regarded as accidental, occur in the region where on the new theory the extreme isothermal values of the Joule-Thomson effect occur at appreciable pressures. A,N_2, CO_2, etc., give similar results. The author finally discusses the physical significance of the condition $p = 0$. [See following Abstract.] H. H. Ho.

1766. Limiting States of Dilution. W. Jacyna. *Zeits. f. Physik,* **99. 1–2.** ***pp.*** **159–160, 1936.**—The condition $p = 0$ for the case of thermodynamical limiting dilution has been considered [see preceding Abstract] and found to be in agreement with the theory of light (regarded as a photon gas) proposed by de Broglie and developed statistically by Glaser and electrodynamically by Japolsky. In contrast to the viewpoint of a complementary wave-corpuscular picture, the possibility is briefly discussed of a continuous transition from the thermodynamical to the electrodynamical vacuum based on the Japolsky theory of the electromagnetic vortex-world. H. H. Ho.

1767. Thermodynamic Potential at Constant Volume in Solutions of Strong Electrolytes. J. Yvon. *J. de Physique et le Radium*, 7. *pp.* 93–94, *Feb.*, 1936.—By means of the statistical theory of Liouville, the author has established by simple analysis the fundamental formula of Debye and Hückel in their theory of electrolytes relating to the average distribution of ions in the neighbourhood of each other in a solution in thermodynamic equilibrium. The results obtained are: $F = Ar^{-1}e^{-Br}$ for the force between the ions, $B^2 = 4\pi(\epsilon^2\nu + \dot{\epsilon}^2\dot{\nu})/DkT$, and $A = -(\epsilon^2\nu + \dot{\epsilon}^2\dot{\nu})^2/DkT$, where ϵ and $\dot{\epsilon}$ are the charges, and D is the dielectric constant at temperature T, from which the potential energy due to the electrostatic charges in a volume v of the solution is $-(\epsilon^2\nu + \dot{\epsilon}^2\dot{\nu})Bv/2D$, and the partial pressure due to the electrostatic effects is $-(\epsilon^2\nu + \dot{\epsilon}^2\dot{\nu})B/6D$. It is then deduced that the value to be added to the thermodynamic potential at constant volume is $-(\epsilon^2\nu + \dot{\epsilon}^2\dot{\nu})Bv/3D$, which is the correction found by Debye and Hückel. H. H. Ho.

1768. Equilibrium and Free Energy in Acetone-Diacetone Alcohol System. G. L. Davis and G. H. Burrows. *Am. Chem. Soc., J.* 58. *pp.* 311–312, *Feb.*, 1936.—Through equilibrium measurements, the free energy change and the heat of reaction accompanying the transformation of acetone into diacetone alcohol are determined. Measurements of the vapour pressure of pure acetone and of its partial pressure above the equilibrium mixture at 25° give evidence that the mixture forms a perfect solution, and confirm the validity of the free energy calculation. The vapour pressure of diacetone alcohol at each of several temperatures is measured. AUTHORS.

See also Abstracts 1416, 1447, 1458, 1505, 1753.

VAPOUR PRESSURE.

1769. Saturation and Partial Pressures of Carbon Tetrachloride-Methyl Alcohol Mixtures. N. Fontell. *Soc. Scien. Fennica*, 8. 15. [19 *pp.*], 1935. The dependence of the saturation pressures of CCl_4–MeOH mixtures on the composition is determined at 20° C. by means of a somewhat modified Smith-Menzies' method. The partial pressures are calculated from the total vapour pressure curve for the liquid mixture. Tests are made to ascertain whether the composition of the vapour can be determined by the distillation method in which the refractive index is measured by an interferometer. It is found that the partial pressures of the CCl_4 derived from the interferometer observations are invariably less than those obtained from the total vapour pressure curve. This is thought to result from the rate of evaporation of CCl_4 being less than that of MeOH. Using Na-light the values obtained for the refractive indices of CCl_4 and MeOH vapours at N.T.P. are $1{\cdot}001796_4$ and $1{\cdot}000561_8$ respectively. R. W. P.

***1770. Solutions of Inorganic Compounds in Liquid Ammonia. Part III. Vapour Pressures. M. Linhard.** *Zeits. f. phys. Chem.* 175. *Abt.A.* 6. *pp.* 438–458, 1936.—Continuing previous work [see Abstract 972 (1934)] vapour pressure measurements are carried out upon solutions of the following salts in liquid NH_3 at 0° C. and at concentrations from 0·2 normal up to saturation: LiCl, NaCl, NH_4Cl, NaBr, KBr, RbBr, CsBr, AgBr, NH_4Br, NaI, KI, RbI, CsI, AgI, NH_4I, $NaNO_3$, KNO_3, $Ca(NO_3)_2$, $Sr(NO_3)_2$, $Ba(NO_3)_2$. A description is given of a manometer suitable for absolute and differential measurements of this kind up to pressures of several atmospheres. It is concluded that the salts investigated are dissociated to a less degree in liquid NH_3 than in water and that some are strongly associated at moderate concentrations. The Raman spectrum of a solution of AgI in liquid NH_3 is observed and indicates the presence of complexes. The results are taken as evidence that for the alkali and ammonium halides the solvation increases from the chlorides to the iodides and from Cs to Na. The solvation of the alkaline earth nitrates is especially high. Solubility runs parallel to solvation amongst corresponding salts. L. A. W.

1771. Activity of Water in Barium Chloride Solutions. R. F. Newton and E. A. Tippetts. *Am. Chem. Soc., J.* 58. *pp.* 280–282, *Feb.*, 1936.—The vapour pressures of $BaCl_2$ solutions are measured at 25° by an air saturation method. The activity of water in $BaCl_2$ solutions is calculated from the Hückel equation, using the constants obtained from the e.m.f. measurements of Tippetts and Newton [see Abstract 4259 (1934)]. The results of the two methods are in very good agreement with each other, but not in agreement with those of Hepburn, which are internally somewhat inconsistent. AUTHORS.

1772. Vapour Pressure of Small Drops and Crystals. A. Frumkin and N. Fuchs. *Acta Physicochimica,* 3. 6. *pp.* 783–790, 1936. *In German.*—The Thomson equation for the vapour pressure of a liquid drop is obtained by application of molecular kinetic theory. The method of Kaischew and Stranski is applied to determine the correction to this equation for very small homopolar crystals with simple cubic lattice, for which the attractive force between the lattices is assumed to decrease as the 7th power of the distance. For even the smallest possible crystal this leads to the conclusion that the Thomson equation gives the correct order of magnitude for the vapour pressure. R. W. P.

See also Abstracts 1458, 1566, 1753, 1768.

ACOUSTICS.

1773. Coordination of the Different Types of Oscillations. L. Bouthillon. *Soc. Franç. Élect., Bull.* 6. *pp.* 151–182, *Feb.*, 1936.—A résumé is given of the main points of a general theory of mechanical, acoustic, optical and electric oscillations. A start is made from the classical results of the study of mechanical systems near the state of equilibrium, for which the motional equations are a system of linear equations of the second order with constant coefficients, the determinant of the coefficients being symmetrical. The equations for electrical networks, which Maxwell showed to be identical with the above, are next considered. The significance of the terms representing the coupling is explained both for mechanical and electrical systems. The oscillations of electromechanical systems are then discussed by comparison with gyroscopic systems. The differential equations for these are again linear and of the second order, with constant coefficients, but the coupling terms are now equal two by two and of contrary signs. The general characters of the solutions of these equations are indicated, as well as the importance and the diversity of their applications. The second part of the paper is concerned with electricity and non-linear mechanics. Recent work in this connection is reviewed and correlated with the fundamental work of Poincaré. The phenomena of the damping of auto-maintained oscillations, of forced oscillations, of auto-synchronisation and of frequency multiplication and division, all come within the realm of non-linear effects. In the third part of the paper are grouped studies relative to mechanical, acoustic, electric and optical oscillations of continuous media. The way in which the wave equation enters into these different fields is recalled and among the applications are considered stationary and progressive waves, interference, reflection, refraction and diffraction. The fundamentals and the general results of a comprehensive study of the wave equation are indicated and the paper concludes with a short review of the connection between oscillations and wave-mechanics.

A. W.

***1774. Production and Measurement of Slow Sine-Waves of Air Pressure. G. v. Békésy.** *Ann. d. Physik*, 25. 5. *pp.* 413–432, *March*, 1936.—Two methods are described for producing slow sine-wave vibrations free from overtones in air. In one the pressure variations are produced by a pump in conjunction with mechanical acoustic filters. The method is suitable for large variations of pressure. The second method consists in passing two high-frequency currents through the heating wire of a thermophone, by which powerful sound pressure variations can be obtained. If the two currents are free from overtones, pure deep difference tones are produced which can set up, in the ear passage, sound pressures up to 20 gm./cm^2. An acoustic analogy to the Wheatstone bridge is described by which the impedance of the tympanum for low frequencies can be measured. With a bridge of this kind records of the nonlinear distortions of the tympanic vibrations were obtained. With normal sound pressures these distortions are not present in the vibrations of the tympanum. [See Abstract 2670 (1935).] G. E. A.

***1775. Pneumatic Production of H.F. Sound. J. Hartmann.** *J. de Physique et le Radium*, 7. *pp.* 49–57, *Feb.*, 1936.—As a source of h.f.

sound a jet of air directed towards a small cylindrical resonator and having a velocity greater than that of sound is used. A radiation efficiency of about 5 % is claimed and acoustic powers of over 100 W and frequencies as high as 500,000 ~ are mentioned. The intensity of the sound produced is large enough for the waves to be photographed by the Schlieren method. An experimental study is made of the action of the sound generator and Schlieren photographs of the jet vibrations are shown. Measurements with a Pitot tube reveal periodic velocity changes along the length of the jet and it is found necessary for the resonator to be placed at a point at which the curve of Pitot reading/distance is rising. Reference is made to the Riemann wave obtained when the jet impinges on an obstacle. The sharp pressure change which occurs at the boundary of this wave makes it possible to use it as an optical mirror and hence to use it similarly to an oscillograph mirror to record photographically the air vibrations in the jet. Records obtained in this way are reproduced. J. E. R. C.

1776. Existence of Scattered Ultrasonic Radiation in Liquids. P. Biquard. *Comptes Rendus*, 202. *pp.* 117–119, *Jan.* 13, 1936.—The fact that the absorption of h.f. sound in liquids is very much greater than the classical theory of Stokes and Kirchhoff indicates may be explained by the radiation being scattered in the liquid. An experiment is described in which an attempt is made to detect the scattered radiation. Radiation passes from a quartz crystal into toluene and a torsion balance is used to detect radiation leaving the beam at right angles. Radiation, which cannot be explained as due to internal reflections at the walls of the experimental vessel, is observed and attributed to scattering. J. E. R. C.

1777. Reaction of Surrounding Liquid to Vibrations of Quartz Plate. H. E. R. Becker. *Ann. d. Physik*, 25. 4. *pp.* 359–372, *Feb.*, 1936.—When a quartz plate immersed in a liquid is set in vibration, the pressure-amplitude of the wave propagated by it is small in comparison with what would be expected from the measured amplitude of the voltage applied to the quartz. The liquid moves only a small part of the way with the quartz, then separates from it, and the two come into contact again near the end of the excursion. The motion of the quartz is an anharmonic vibration for which the law of force is given. Different liquids were tested, and the measured resonance curves are all in agreement with the hypothesis given above. G. E. A.

1778. Diffraction of Light by Supersonic Waves. S. M. Rytow. *Phys. Zeits. d. Sowjetunion*, 8. 6. *pp.* 626–643, 1935. *In German.*—With decrease of the wave-length of supersonic waves the spacial nature of the diffraction of light by such waves is more and more in evidence; the energy distribution approximates more and more towards the distribution for selective reflection, which satisfies Bragg's condition. A theoretical and experimental study is here presented of the transfer region from the diffraction by a two-dimensional grid to the selective reflection by a three-dimensional layered structure. The experimental results are found to be in good agreement with theory. A. W.

1779. Diffraction of Light by Supersonic Waves. Part III. C. V. Raman and N. S. N. Nath. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 75–84, *Jan.*, 1936.—The theory of diffraction is further developed [see Abstract 785 (1936)] to find the Doppler effects in the diffraction components produced by the passage of light through a medium containing (i) a progressive supersonic wave, (2) a standing supersonic wave. The results satisfactorily interpret the recent experimental results of Bär, that any two odd or even orders partly cohere, whilst an odd and even one are incoherent. G. E. A.

1780. Debye-Sears Diffraction Effect and Energy Relation in the Production of Ultrasonic Waves. H. E. R. Becker. *Ann. d. Physik.*, 25. 4. *pp.* 373–384, *Feb.*, 1936.—An optical method is described by which the sound intensity and mean pressure-amplitude of a progressive ultrasonic wave may be determined. It is based on the Debye-Sears method of diffraction. The Debye theory is adopted in a modified form, and the sound energy radiated per sec. is calculated from the intensity of the diffracted light. The theory as a first approximation is confirmed, and within its range of validity gives good agreement between the output of radiated sound and the electrical input to the quartz. The theory, according to which the diffraction intensity of the first order increases linearly with the sound output, does not hold for large amplitudes. The first order has a maximum of intensity which diminishes with larger pressure-amplitudes. The total intensity of the diffracted light can be satisfied by a tangent law. G. E. A.

***1781. Audition of Sound in a Closed Space. R. Fleurent.** *Comptes Rendus*, 202. *pp.* 30–32, *Jan.* 6, 1936.—The author develops an apparatus for investigating the acoustics of auditoria. Beyond mentioning that a crystal microphone in association with an amplifier and oscillograph is used no account is given of the apparatus. From his results the author deduces that the character of the decay which occurs in the first 0·2 sec. is of considerable importance. J. E. R. C.

1782. Influence of Material upon the Sound Reduction of Single Walls. E. Lübcke. *Zeits. f. techn. Physik*, 17. 2. *pp.* 54–57, 1936.—In an attempt to trace the origin of the discrepancies between sound-insulation measurements made in various Continental laboratories, a series of measurements is made upon brick and clinker concrete walls built in different ways. It is calculated that brick walls built in lime mortar transmit sound more freely than those in which cement mortar is used. This is ascribed to the greater rigidity of the latter wall. It is also found that cement plaster produces a somewhat higher sound reduction than lime plaster. Hair cracks in the plaster cause a greatly reduced sound insulation and may be responsible for some discrepancies. No definite evidence is obtained that the dimensions of the test rooms and specimen influence the result. A description of the acoustical laboratories of the Physikalische Institut, Brunswick, is also given. K. M. C.

1783. Recognition of Pitch. W. Bürck, P. Kotowski, and H. Lichte. *Ann. d. Physik*, 25. 5. *pp.* 433–449, *March*, 1936.—In some previous measurements [see Abstract 273 (1936)] the authors measured the time for which a note must be sounded in order that its pitch should be recognised. This " recognition time " is a minimum for frequencies round about 1000 ∼. In the present paper an attempt is made to calculate the form of the curve relating the " recognition time " with the frequency. An approximate expression is used for the distribution of energy in the spectrum of a short wave train. To obtain the effect of such a wave upon the ear the effective energy distribution is obtained by correcting this expression for the variation of ear sensitivity with pitch. For this purpose it is assumed that the expression $I_\omega = k\Delta\omega/(\Delta^2 + \omega^2)$ represents the ear sensitivity. (I = sensitivity, ω = frequency, Δ = frequency of maximum sensitivity. The total effective energy in the spectrum of the wave train is then calculated and also the effective energy contained in a frequency band distributed round the main frequency of the wave. By assuming that for a definite pitch to be recognisable a definite fraction of the total effective energy must lie in this band a curve connecting the recognition time with frequency is obtained. Good agreement with the experimental results is obtained by making the band width ± 5 % and the necessary fraction 70 %. The suitability of these values is confirmed by another experiment in which a short period impulse excites an oscillating circuit, the damping of which is adjusted until a definite pitch is perceptible in the note emitted in a telephone connected to the circuit. J. E. R. C.

1784. Audibility of Transient Oscillations. W. Bürck, P. Kotowski and H. Lichte. *E.N.T.* 13. *pp.* 1–12, *Jan.*, 1936.—Earlier work [see Abstract 273 (1936)] indicates that the tonality and loudness of acoustic wave-forms can be calculated. Experiments are made with a switched tone, the period of switching being both smaller and greater than the period of the tone. The theoretical spectral distributions of the energy in such switched tones are calculated and compared with experiment when the output from a simple resonant circuit is examined. The relative spectral components are regulated by increasing the switched amplitudes gradually with a known time-constant, which is a resistance-capacity network altering the bias on a push-pull stage; the output is observed with telephones, with or without an additional acoustic path provided by a loudspeaker and microphone. The agreement between the time-constants as determined by the resonant distorting circuit and the known time-constants as balanced by the ear is good. Modifications for more than one resonant circuit are described. L. E. C. H.

***1785. Study of Interference through Acoustics. H. K. Schilling and W. Whitson.** *Am. Phys. Teacher*, 4. *pp.* 27–31, *Feb.*, 1936.—The usual approach to the study of interference, in elementary courses, is mainly by way of optics, a procedure that has certain serious drawbacks. The beginner might find the approach through acoustics more natural and interesting. This paper describes simple acoustical apparatus for laboratory and demonstration, and the following fundamental experiments on interference of sound waves: double slit; thin films; standing waves; Lloyd's mirror; Fresnel's mirror; effect of plane reflector near point source. AUTHORS.

See also Abstracts 1414, 1433, 1472, 1752.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

1786. Matrices in Electric Circuit Theory. R. S. Burington. *J. Math. Phys.* 14. *pp.* 325–349, *Dec.*, 1935.—A short synopsis of certain manifestations of matrix algebra which have arisen in electric circuit theory are discussed, though no attempt is made to give more than an outline of certain phases of the subject. The first part is devoted to purely mathematical considerations, starting with a discussion of certain types of equality relationships in matrix algebra and their accompanying theories. The second part is concerned with a discussion of these principles in electric circuit theory. The introduction of the concept of direct sum into the electrical theory given here should be of particular interest in clearing up certain difficulties in the literature.

See also Abstracts 1822, 1878, 1898, 1899.

CONDUCTION AND DISCHARGE IN GASES.

1787. Theory of "Pipe" Discharge. R. Seeliger and K. Sommermeyer. *Zeits. f. Physik*, 98. 11–12. *pp.* 733–739, 1936.—The foundations of a theory of the contraction of the cross-section of a discharge, such as has been observed in electronegative gases, are developed. The essential feature of the theory is that the electrons moving outwards in the concentration gradients are transformed by additions into negative ions and that these ions then reverse and move inwards. According to the conditions of experiment the ions will disappear owing to recombination or de-ionisation, in consequence of which two fundamental types of pipe discharge may be distinguished. A. W.

1788. Theory of Lowering of Striking Potential of a Spark-Gap Subjected to Radiation. W. Fucks. *Zeits. f. Physik*, 98. 11–12. *pp.* 666–671, 1936.—In a previous paper [see Abstract 3132 (1935)] it was shown that the lowering of the striking potential of a spark-gap subjected to weak radiation is to a first approximation proportional to the square root of the electron current released photoelectrically at the kathode. The observed departure of the lowering of the striking potential from the square root law is here derived theoretically. The calculation shows that to a second approximation a straight line graph of small slope is to be subtracted from the square-root curve. A. W.

1789. Electric Breakdown of Gas Mixtures. G. M. Kovalenko. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1.1. *pp.* 15–17, 1936. *In German.*—Measurements of the breakdown voltage of gas mixtures are described between spherical electrodes at atmospheric pressures and room-temperature of mixtures of N_2 and NH_3 at concentrations varying between 100 % N_2 and 0 % NH_3 and 0 % N_2 and 100 % NH_3. The breakdown voltage of N_2 falls with the addition of NH_3 to a minimum value at about 30 % NH_3 and then rises again to the breakdown voltage of pure NH_3. Further experiments of a similar nature are described with mixtures of N_2 and $(C_2H_5)_2O$ and of N_2 and H_2. R. L.

1790. Investigation of Air Breakdown with the Kathode-Ray Oscillograph. M. Messner. *Arch. f. Elektrot.* 30. *pp.* 133–137, *Feb.* 18, 1936.—The breakdown of air between brass disc electrodes, 10 cm. dia.

and 2 cm. gap is investigated with impulse voltages. The d.c. breakdown of the gap is approximately 60 kV and overvoltages up to 100 kV total are used. The test voltage is supplied from an impulse generator giving voltages symmetrical about earth, through a line 75 m. long, terminated by a resistance equal in value to the surge impedance of the line, and the gap, in parallel. The voltage applied to the gap is measured directly with the kathode-ray oscillograph without the intermediary of a voltage divider. No special gap illumination is used. The voltage applied to the gap is approximately rectangular, the length of the front being 10 m. The relation between the over-voltage and the time lag in the breakdown of the gap is determined, the latter being defined as the time interval between the instant of breakdown and the instant when the d.c. value is reached. This relation is hyperbolic. Time lags between $0 \cdot 2 \times 10^{-7}$ and $3 \cdot 5 \times 10^{-7}$ sec. for overvoltages up to 60 % are obtained, the spread in the results being small. The short delay in gap breakdown indicates that positive ionisation on the kathode plays no part in initiating the impulse voltage breakdown. R. D.

1791. Dynamic Characteristics of the Mercury Arc. W. Elenbaas. *Physica*, 3. *pp.* 12–30, *Jan.*, 1936. *In German.*—An a.c. is superposed on the d.c. of a high pressure Hg discharge (pressure from 1/6 to 100 atm.). The frequency of the a.c. is varied from 50 to 14,000 ∼. By increasing the frequency from 60 to 14,000 ∼ the phase difference between voltage and current diminishes from about 150° to 25°, whereas the a.c. conductivity divided by the d.c. conductivity first increases, passes through a maximum at about 300 ∼ and finally decreases. In the limiting case of infinite frequencies the ratio may possibly reach unity. Oscillographic records of current and voltage are given. At 50 ∼ the modulation of the light from the arc is greater than that of the current or the supplied energy. The modulation calculated from the current and voltage curves by assuming temperature equilibrium between the different groups of particles in the arc and making use of Saha's formula and the Boltzmann distribution is greater than the measured one and may become twice the latter. This is attributed to the neglect of absorption, which is greater in the period of maximum than of minimum light. By using the energy balance equation for the discharge combined with Saha's theory, it is possible to calculate the characteristics of the discharge when only the form of the current curve is given. The temperature curve as a function of the phase calculated in this way agrees very well with that determined experimentally and the calculated voltage curve also agrees fairly well with the measured one. A. W.

***1792. Characteristics of High-Current, Short-Period Arcs. A. Wallraff.** *Zeits. f. techn. Physik*, 17. 2. *pp.* 44–47, 1936.—Apparatus is described for the production of momentary atmospheric pressure arcs, carrying currents up to 5,000 A. The characteristics of these arcs are investigated by means of a kathode-ray oscillograph. It is shown that the arc voltage is independent of the strength of the current. J. E. R.

1793. Variations of Field Strength and Current Density in A.C. Arcs. D. T. J. ter Horst. *Physica*, 3. *pp.* 131–140, *March*, 1936.—A series of kathode-ray oscillograph measurements is made on a.c. arcs with frequencies of 50 and 250 ∼. It is shown that the field strength is a periodic function of the phase, but the sharp maximum in the impressed voltage curve almost disappears. The Ayrton law relating field strength and current is shown to hold at all points in the cycle. The mean value of the field strength is in good agreement with that found in a d.c. arc under similar current conditions. Measurements of current density show that this is independent of arc length and mean effective current. J. E. R.

***1794. Absolute Values of the Electron Mobility in Hydrogen. N. E. Bradbury and R. A. Nielsen.** *Phys. Rev.* **49.** *pp.* **388–393,** *March* **1, 1936.**—A new method is described for the measurement of electron mobilities in gases. An electrical shutter method is employed in which the shutters take the form of two fine wire grids, alternate wires of which are connected to a h.f. alternating potential. Electrons pass through the grids only when the potential between adjacent grid wires is zero, and only electrons which cross the gas space in one half-cycle are received at the collecting electrode. A sharp maximum is thus observed in the electrometer current when the drift velocity of the electron multiplied by the time of one half-cycle is equal to the distance between the grids. The theoretical shape of the current curve is compared with experiment and good agreement observed. Measurements are made between X/p of 0·03 and 20, and the values obtained are compared with the Compton mobility equation. AUTHORS.

1795. Rotation Temperature of the Column of a Discharge. T. Hamada. *K. Akad. Amsterdam, Proc.* **39. 1.** *pp.* **50–57, 1936.**—The N_2 second positive band $\lambda 3998$ and the N_2^+ negative band $\lambda 3914$ in a d.c. discharge in a water-cooled end-on N_2 tube (design described) are photographed in a stigmatic grating spectrograph with dispersion 2·6 Å/mm., and the temperature of the column in the capillary is determined from measurements of intensities of resolved lines in both bands. Seven currents ($i = 25$ to 175 mA.) and seven pressures ($p = 10^{-2}$ to 30 mm.) are used, and the temperature on the axis of the tube is found to be $T = 850 + 0{\cdot}385\,pi$ °K. The energy used in the column is also a function of pi. For constant p and i the radial distribution of temperature from axis towards wall is nearly parabolic, the temperature at the wall being lower than that given by extrapolation of the parabola but higher than that calculated from the heat conducted through the wall to the water. The total intensity of the $\lambda 3914$ band on the axis is nearly proportional to i and nearly independent of p. The axial fall of total intensity is steeper for the $\lambda 3998$ than for the $\lambda 3914$ band. W. J.

1796. Pressure Effect on Discharge Radiation in Mercury Vapour. V. Fabrikant, F. Butajeva and J. Cirg. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.,* **4. 4–5.** *pp.* **183–184, 1935.** *In German.*—The non-detection of a minimum in the intensity of radiation from Hg discharges as pressure is gradually increased is discussed in relation to effects of addition of an indifferent gas, such as were observed in Cd [see Abstract 806 (1936)]. In Hg + A the intensity in the visible region first remains constant and then falls off rapidly; in Hg + Ne a minimum occurs which is sharpest with very little Ne; and as in the case of Cd, A is more effective than Ne. In Hg, as in Cd, there must be considerable reabsorption of the visible triplets in a low-pressure discharge. This is verified by absorption measurements by a mirror—or autocollimation—method for Hg discharges at 10^{-2} mm. The absorption of $\lambda 4358$ ($> 65\,\%$) exceeds that of $\lambda 5464$, which exceeds that of $\lambda\lambda 4960$, 5770 and 5790. These high reabsorptions exceed those in a high-pressure discharge, and explain the deviations of the observed intensity ratios of the visible Hg triplets in low-pressure discharges from the ratios given by the intensity rules. W. J.

1797. Discharges Produced in Mercury by Frictional Electricity. F. Halla and W. Ritter. *Zeits. f. techn. Physik*, 17. 2. *p.* 44, 1936.—The green flash discharge observed when Hg is agitated under low pressure, as in a diffusion pump, is investigated by means of a spectrograph. In the region 5912–3651 Å, 34 sharp lines are observed and identified with known lines of Hg and the gases present in the apparatus. No evidence is found of the continuous spectrum reported by previous observers. J. E. R.

1798. Glow Discharge through Oxygen. F. D. Greeves and J. E. McF. Johnston. *Phil. Mag.* 21. *pp.* 659–686, *March*, 1936.—Results of an extensive series of probe measurements in negative sections of the cold-kathode glow discharge in oxygen are described. Tests are carried out to investigate the importance of possible sources of error. A range of conditions under which probes can be used has been found. Typical data are given for electron energy distributions and concentrations, and for the potential in the discharge. AUTHORS.

1799. Molecular Orientation and the Excitation and Dissociation Probability of the Hydrogen Molecule by Electron Impact. N. Sasaki and T. Nakao. *Imp. Acad. Tokyo, Proc.* 11. *pp.* 413–415, *Dec.*, 1935. *In German.*—It has previously been shown experimentally [see Abstract 3606 (1935)] that the probability of ionisation of the hydrogen molecule by electron impact is the greater the nearer the direction of the electron to the molecular axis. In the present paper it is shown theoretically that the excitation of the hydrogen atom by electron impact should exhibit a similar orientation effect. Experiments to test this are in progress. A. W.

1800. Interpretation of Electron Impact Experiments with Carbon Monoxide. R. Schmid. *Zeits. f. Physik*, 99. 3–4. *pp.* 274–280, 1936.—It is shown that the critical potential values of CO which have been found experimentally may be explained on the assumption of D(CO) = 6·9 V, recently proposed by Schmid and Gerö, and with reference to the calculated position of the ^{5}S-terms of tetravalent C. Since the heat of evaporation of solid C is calculated from the experimental data to be 177 k.cal. by application of D(CO) = 6·9 volts to the process $C_{solid} \rightarrow C(^5S)$, values for the bond energies of C-C and H-C may now be derived which agree well with the data obtained by thermochemical methods. The possibility of the dissociation of the CN-molecule into $C(^5S) + N(^4S)$-atoms is again brought forward. As the result of further work on the interpretation of electron impact experiments with CO$_2$, it is concluded that the impact procedure in CO runs as follows: $CO(X'\Sigma + 6$ volts $\rightarrow CO(a^3\Pi)$, $CO(a^3\Pi) + 5{\cdot}2$ volts $\rightarrow C(^5S) + O(^3P)$. H. H. Ho.

1801. Effects of Exchange Forces on the Excitation Function of Li^7 under Proton Bombardment. M. Ostrofsky, W. E. Bleick and G. Breit. *Phys. Rev.* 49. *pp.* 352–354, *March* 1, 1936.—In a recent paper van Vleck [see Abstract 3708 (1935)] gave an approximate method of estimating the effective potential due to Majorana exchange forces, which acts on a proton or neutron when they collide with a nucleus. The effective potential obtained in this manner varies with velocity. Calculations reported on here show that the effect of this variation with velocity on the shape of the excitation curve of lithium under proton bombardment is small and is of no practical importance. The position of stationary proton levels which are consistent with the excitation curve is affected seriously. Agreement of calculations with the mass defect of Be^8 is materially improved through the use of the exchange potential. With a radius $0 \cdot 35 \times 10^{-12}$ cm. the empirical mass defect of Be^8 is accounted for perfectly by the calculation which simultaneously fits the excitation curve for the 8-cm. particles. AUTHORS.

1802. Total Ionisation by Slow Kathode Rays near the Ionisation Potential. E. Breunig. *Ann. d. Physik*, 25. 5. *pp.* 467–480, *March*, 1936.—The mean energy loss per ion pair in air ionised by photoelectrons is measured at different pressures for potentials below 160 V. Owing to the inhomogeneity of the velocity distribution of the electrons, a differential method is employed by which the energy loss per pair may be determined for different velocity groups. The measurement of electrons and ions takes place under similar conditions of pressure and electrical field. It is found that the electron velocity distribution depends on the pressure and this permits an extension of the method to the case of small velocities. In the range 160-70 V, the value of the ion loss per pair (ϵ) agrees with the already accepted value of 34 V for higher potentials. From 70 V down to the ionisation potential, ϵ steadily rises to 70 V (economy coefficient 1/3 to 1/6). This result agrees with that given by Freund. H. J. H. S.

***1803. Source of Doubly-Ionised Helium. O. Luhr.** *Phys. Rev.* 49. *pp.* 317–319, *Feb.* 15, 1936.—A magnetron type of l.v. arc is designed to produce doubly charged He ions by multiple electron impact. A magnetic field parallel to the axis of a cylindrical kathode makes it possible to operate the arc in pure He with 1 A arc current and an arc drop of 50 to 100 V, at a pressure of 10^{-2} mm. Ions are drawn out of the arc and focussed on an ion gun by an auxiliary kathode fitted with a spherical grid. When the ion beam is analysed with a mass spectrograph it is found that about 5 % of the ions have a ratio of mass to charge equal to 2. At least part of these are H_2^+ ions appearing as an impurity which cannot be eliminated. However, with an ion beam of 1 mA which can be readily drawn from the arc, there is evidence to indicate that about 2 %, or 20μA, consists of doubly ionised He which is available for nuclear investigations. AUTHOR.

***1804. Sensitive Counting Device. E. B. Andersen.** *Zeits. f. Physik*, 98. 9–10. *pp.* 597–604, 1936.—Several Geiger counters are connected with an amplifier in such a way that impulses of the first counter only are registered unless a coincidence occurs between the first and one of the other counters. The use of this compensation device together with lead shields, allows the natural effect to be reduced to about one-fifth of that for a single counter as ordinarily used. F. C. C.

***1805. Ionisation Gauge for Atomic Beam Measurements. R. D. Huntoon and A. Ellett.** *Phys. Rev.* 49. *pp.* 381–387, *March* 1, 1936.—Use of two types of current measuring devices, galvanometer and valve amplifier, with an ionisation gauge shows that the stable sensitivity, positive ion current/mm. gas pressure (current fluctuation) is greater for low electron emission densities thus favouring the use of the amplifier with its greater current sensitivity. Such factors as electrode size, relative potentials, electron emission, interelectrode leakage, type of inlet, gas adsorption, surface charges, temperature changes, B.K. oscillations, and variations of pumping speed which influence the design of a gauge are discussed and an arrangement to fulfil the necessary requirements is described. Performance tests show the gauge to be capable of measuring beam pressure changes at least as small as 3×10^{-11} mm. of Hg or approximately 3×10^9 Hg atoms per cm^2. per sec. AUTHORS.

See also Abstracts 1402, 1584, 1609, 1654, 1682, 1845.

CONDUCTION IN SOLIDS AND LIQUIDS.

1806. Inertia of Electrons in Metals. C. G. Darwin. *Roy. Soc., Proc.* 154*A*. *pp*. 61–66, *March* 2, 1936.—In the theory of metals it is believed that the effective mass of the free electrons is increased on account of the disturbance of their energy levels by the field of the lattice. It is shown here that such an effect will not be exhibited in experiments on electron-inertia. This is in conformity with the experiments of Tolman and others [see Abstract 1130 (1927)]. AUTHOR.

1807. Supraconductive Tantalum. K. Mendelssohn and (Miss) J. R. Moore. *Phil. Mag.* 21. *pp*. 532–543, *March*, 1936.—The magnetic threshold curve and the penetration curve of supraconductive tantalum are determined. The discrepancy between these curves is discussed in respect to the thermodynamical behaviour of small supraconductive regions. AUTHORS.

1808. Relaxation Phenomena in the Transition from the Supraconductive into the Non-Supraconductive State. W. H. Keesom and P. H. van Laer. *K. Onnes Lab., Leiden. Comm. No.* 240*c*. *Physica*, 3. *pp*. 173–181, *March*, 1936.—The transition from the supraconductive into the non-supraconductive state takes place, as revealed by experiments on tin, with a relaxation of several seconds, if it is caused by an increase of temperature of the substance, while a constant magnetic field is applied. No such relaxation (at least not to an amount of seconds) occurs if the transition is the consequence of an increase of the external magnetic field. These experimental facts are in harmony with the views that, the threshold value curve being reached, there is a weak coupling between the atomic lattice and the system of supraconductive electrons, and that there is a strong coupling between the external magnetic field and the system of supraconductive electrons as well as between the non-supraconductive electrons and the atomic lattice. AUTHORS.

1809. Transition of a Monocrystalline Tin Sphere from the Supraconductive to the Non-Supraconductive State. W. J. de Haas and O. A. Guinau. *K. Onnes Lab., Leiden. Comm. No.* 241*a*. *Physica*, 3. *pp*. 182–192, 1936. *In English*.—The study of the penetration of a magnetic field into a supraconductive tin cylinder [see Abstract 2190 (1934)] is extended to monocrystalline tin spheres, for which the demagnetisation factor is known. A magnetic field was applied to the sphere and its intensity increased at constant temperature until supraconductivity was entirely disturbed. It was concluded that the apparent permeability of the sphere is zero so long as the applied field strength is lower than two-thirds of the field which disturbs supraconductivity entirely. The permeability increases linearly until it reaches the value unity when the applied field, attains the critical value. The transition was also studied in a constant external field while the temperature was being raised. G. E. A.

1810. Electrical Conductivity and Phase Diagram of Pd-Co Binary Alloys. G. Grube and H. Kästner. *Zeits. f. Elektrochem.* 42. *pp*. 156–160, *March*, 1936.—The temperatures corresponding to the solidus and liquidus of the Pd-Co system are given for increments of 5 atomic % Pd. The freezing point is a minimum at 1217° C. and 50 atomic

% Pd. Temperature-resistance curves for the whole range of alloys as well as the Curie points are given for temperatures between 40 and 1000° C. The data so obtained are summarised in a phase diagram which is similar to that of the Pd-Ni system. The $\alpha \rightleftarrows \beta$ transformation of Co in Co-rich solid solutions, which is evident on the temperature-resistance curves, is studied by taking differential heating and cooling curves; the transformation occurs between 456 and 474° C. (resistance measurements) and between 442 and 465° C. (magnetic measurements) on heating and on cooling between 408 and 370° C. For pure Co the ranges are 440 to 449° C. and 402 to 387° C. (magnetic measurements) respectively. H. J. H. S.

1811. H.F. and L.F. Conductivities of Electrolytes in Glycerin and Glycerin-Water Mixtures. J. Hiegemann. *Ann. d. Physik,* 25. 4. *pp.* 337–358, *Feb.*, 1936.—Conductivities of solutions especially very dilute ones, of KCl and $MgSO_4$ in glycerin and glycerin-water mixtures are measured at low frequencies, and over a range of wave-length from 20 to 90 m. The increase of conductivity with frequency is in many cases so much greater than is to be expected from dipole theory that no explanation is for the moment attempted. W. H. W.

1812. Conductance of Salts in Benzene and Dioxane. W. F. Luder and P. B. Kraus with C. A. Kraus and R. M. Fuoss. *Am. Chem. Soc., J.* 58. *pp.* 255–258, *Feb.*, 1936.—Conductance data for the following systems are presented: tetraisoamylammonium iodide in benzene at 60°; silver perchlorate, tetrabutyl-ammonium perchlorate and acetate in benzene at 25°; and tetrabutylammonium perchlorate and acetate in dioxane at 25°. The conductance curves show minima at low concentrations, below which the conductance rises in accordance with the law of mass action for binary equilibria. The marked specific effect of structure on conductance in solvents of very low dielectric constant is pointed out. AUTHORS.

See also Abstracts 1427, 1443, 1517, 1620, 1770, 1813, 1814, 1845, 1876, 1898, 1899.

DIELECTRICS AND CAPACITANCE.

1813. H.F. Insulating Materials at High Temperature. G. Straimer and O. Zinke. *A.T.M.*5. *T*27–28, *Feb.*, 1936.—Measurements, by a resistance-substitution method, are reported on the power factors of a number of insulating materials at temperatures up to 300° C., and at frequencies between 1 and 20 megacycles/sec. In general the power factor increases steadily with temperature, and to a greater degree at low frequencies than at high. Two exceptions were Frequenta, which had power factors of approximately 0·0005 at 25° C., 0·0011 at 125° C., 0·0010 at 200° C. and 0·0012 at 300° C., the values being slightly different with increasing and decreasing temperature; and Tempa S, which has a power factor below 0·0001 up to 150° C., rising to 0·001 at 300° C. Representative values at 25° C. and 300° C. are: Glass No. 1, 0·007 and 0·1; Glass No. 2, 0·002 and 0·01; Glass No. 3, 0·008 and 0·1; Frequenta D, 0·0004 and 0·001; Calit, 0·0005 and 0·004; Diakond, 0·00005 and 0·0002; Kerafar R, 0·001 and 0·05; Kerafar U, 0·0001 and 0·001; Condensa C, 0·0003 and 0·02. W. H. W.

1814. Breakdown Voltage and Conductivity of Anodically Oxidised Aluminium. J. W. Holst. *Zeits. f. Elektrochem.* 42. *pp.* 138–143, *March,* 1936.—Anode films are formed on 99·8 % pure, previously cleaned Al foils in 4 % ammonium borate solution, at a current density of 2 mA per cm^2. requiring 4–16 hr. at room-temperature. Polarisation is minimised by occasional short-circuiting. After drying over P_2O_5 in a desiccator, breakdown voltage is determined between the oxidised plate and a small drop of newly distilled and dried mercury. Penetration voltage is found to be proportional to formation voltage, with zero as origin. Conductivity of the dry film is definitely non-symmetrical, both with mercury and with carbon as contacts, so that the effect cannot be due to amalgamation. Comparative measurements in the immersed and dry states show, in contradiction to the results of others, that conductivity is not dependent on the relative election concentration in the media in contact with the coating, *i.e.* in metal and electrolyte. By suitable treatment, a capacity in the dry state of 50 % to 100 % of that of the film immersed in the electrolyte can be obtained. Complete removal of water from the coating can be carried out only by strong ignition, and conductivity is due to ion migration within the film as electrolyte, OH′-ions passing to the Al, and $\dot{H}$-ions to the opposite electrode, Al_2O_3 or $Al(OH)_3$ and H_2 being formed respectively. The film is probably a slightly hydrated oxide, and during the experiment the change in H_2O content is so small as to be negligible. D. R. H.

1815. Polarity of Nitrogen Tetroxide and Nitrogen Dioxide Molecules. J. W. Williams, C. H. Schwingel and C. H. Winning. *Am. Chem. Soc., J.* 58. *pp.* 197–203, *Feb.*, 1936.—The dielectric constant of the gaseous equilibrium mixture of NO_2 and N_2O_4 is measured at five temperatures between 298 and 398°Abs. and at seven pressures between 150 and 760 mm. With the aid of density measurements already existent in the literature these data are utilised to calculate the electric moments of the NO_2 and N_2O_4 molecules. The polarity of the NO_2 molecule is found to decrease with increasing temperature over the interval studied. It is suggested that this decrease is due to the passage of greater and greater numbers of the molecules into more symmetrical higher vibrational states as the temperature is increased. The dipole moment of the N_2O_4 molecule does not differ greatly, if at all, from zero. Thus the apparent inconsistency between the results of infra-red absorption and dielectric constant studies now existent in the literature, is removed. AUTHORS.

1816. Dielectric Polarisation of Concentrated Solutions. A. Jagielski and J. Wesolowski. *Acad. Polonaise Sci. et Lettres, Bull.* 5–6*A. pp.* 260–269, *May–June*, 1935. *In German.*—Experiments are made to obtain additional data in confirmation of Sugden's method for the determination of dipole moments. According to this method the polarisation P_2 of the solute in a concentrated solution is given by $P_2 = M[(\epsilon_x - 1)/(\epsilon_x + 2). d_x - (\epsilon - 1)/(\epsilon + 2)]/C_2$, where M = the molecular weight of the substance concerned, ϵ, ϵ_x, and d, d_x, = the dielectric constants and densities of the solvent and solute respectively. In many cases P_2 varies linearly with the quantity $(\epsilon - 1)/(\epsilon + 2)$. By extrapolating the curve and determining the difference between the values of P_2 for $\epsilon - 1 = 0$ and $(\epsilon - 1)/(\epsilon + 2) = 1$ (or $\epsilon = \infty$), the value of P_μ which is related to the dipole moment of the solid is obtained. The dielectric constants and density of solutions of *o*-nitraniline, *o*-nitrotoluol, *o*-chlornitrobenzol, *p*-chlornitrobenzol and ethyl-ether in benzene were measured. The values found by this method were in some cases greater and in others smaller than those found by other authors. The cause of these differences is the subject of further investigation. A. M. T.

1817. Dielectric Constants of Diluted, Strong Electrolytes at Different Temperatures. M. Jezewski, M. Wierzbicki and J. Kamecki. *Acad. Polonaise Sci. et Lettres, Bull.* 7–8*A*. *pp.* 417–429, *July–Oct.*, 1935. *In German.*—The dielectric constants increase with increasing concentration, with increasing valency, and with increasing temperature. W. R. A.

1818. Dielectric Constants of Electrolytes. G. Fischer and W. D. Schaffeld. *Ann. d. Physik*, 25. 5. *pp.* 450–466, *March*, 1936.—The dielectric constant K of solutions of electrolytes of concentrations up to $0 \cdot 1N$ is determined by the method of Orthmann. This method is based on measurements of the couple exerted on a metallic ellipsoid of revolution suspended in the solution when an electric field is applied. Since some inconsistent results for NaCl are traced to impurities in the electrodes, specially pure gold electrodes are used for all measurements. A variation of K with frequency traceable to polarisation, vanishes at frequencies of $2 \times 10^5 \sim$. In the case of NaCl and NaI, K decreases with C the concentration in agreement with the formula of Debye and Falkenhagen up to $C = 0 \cdot 01N$. Results obtained for $NaNO_3$, KNO_3, and $AgNO_3$ can be expressed by a similar type of formula while results obtained for HNO_3, HCl and H_2SO_4 require a slightly different formula. J. E. R. C.

1819. Electric Moment of Tantalum Pentachloride and the Structure of AX_5 Compounds. H. Moureu. *Comptes Rendus*, 202. *pp.* 314–316, *Jan.* 27, 1936.—The electric moment of $TaCl_5$ is found to be $1 \cdot 2$ D. The electronic structure of AX_5 molecules is discussed. W. R. A.

1820. Dipole Moment and Solvent. K. Higasi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 621. *pp.* 284–309, *Feb.*, 1936.—The solvent effect can be explained solely from the consideration of induction in the solvent by the dipole of the solute. Calculations are done for several models of solute molecules, and the results are applied to the experimental data with fair success. Measurement of the dipole moments of a few alcohols in benzene solution are reported, and their meaning is discussed. A few methods of obtaining the moment of a free molecule from the measurement in solution are proposed. AUTHOR.

1821. Dielectric Constant and Dipole Loss at High Frequencies. *Phys. Zeits.* 37. *pp.* 155–164, *March* 1, 1936.

"Introduction," by **M. Wien** (*pp.* 155–156).—The effect of the addition of a small quantity of a liquid, in which dispersion occurs at a wave-length λ_1, to a liquid, in which dispersion occurs at a wave-length λ_2, is considered. When λ_1 is small compared with λ_2, the curves connecting dielectric constant and loss with frequency are practically the same for both the mixture and the main liquid. When λ_1 is large compared with λ_2, the dielectric constant-frequency curves are practically unaltered, but the conductivity of the mixture is increased at long wave-lengths.

"Dipole Losses in Liquids with Long Waves," by **C. Schreck** (*pp.* 156–158). For butylalcohol and cane sugar solution, the increase in conductivity due to absorption is proportional to the square of the frequency. With laevulose, the increase in conductivity of dilute solutions is also proportional to the square of the frequency, but for stronger solutions the increase no longer varies in this manner, and finally with highly concentrated solutions the increase is proportional to the frequency.

"Cane Sugar and Laevulose Solutions," by **W. Dahms** (*pp.* 158–160). Measurements on cane sugar and laevulose solutions with short waves show that the rate of increase of conductivity with frequency decreases with increasing strength of solution.

"Glasses," by **W. Hackel** (*pp.* 160–162).—Measurements on four different types of glass show that at first the conductivity increases linearly with the frequency, but as the frequency is increased above 10 to 20 × $10^6 \sim$, the rate of increase of conductivity with frequency diminishes.

"Losses in Liquids by a Thermal Method," by **C. Schmelzer** (*pp.* 162-164).—By a thermal method the losses in various liquids are determined. With *n*-propylalcohol the loss is proportional to the square of the frequency. For a solution of tetra-*n*-butyl-ammonium-bromide in benzene, the losses are not strictly proportional to the square of the frequency, particularly with long waves. At low field-strengths, the losses obey Ohm's Law, being proportional to the square of the voltage, but at higher field-strengths, the losses decrease linearly with increasing voltage, the rate of decrease being greater the higher the frequency. It is concluded that this is due to voltage-dissociation. E. R.

1822. Inductance and Resistance of Variable Air Condensers. R. F. Field and D. B. Sinclair. *I.R.E., Proc.* 24. *pp.* 255–274, *Feb.*, 1936.—An account of the method of finding the inductance, series resistance and shunt conductance of a variable air condenser by measuring the changes in apparent capacitance and power factor at various settings when a small fixed condenser is connected and disconnected. W. H. W.

See also Abstracts **1443**, 1518, 1811.

ELECTROCHEMISTRY.

1823. Gassing of Lead Plate Storage Batteries during Charge and Discharge. W. B. Pietenpol and K. S. Keller. *Physics*, 7. *pp.* 43–49, *Feb.*, 1936.—The gases liberated from different types of lead plate storage batteries during varying conditions of charge and discharge are collected and analysed, and the corresponding changes in battery potential and specific gravity determined. A small amount of gas, mostly H_2, is given off by lead plate batteries during discharge and while idle, but a much larger amount of gassing takes place during the charging process, particularly near the end. In all cases of charging the gas consists almost entirely of H_2 and O_2, with a very small amount of acid vapour and water vapour. However, both the absolute and relative amounts of these gases depend upon the rate and method of charging. When high charging rates are used the gas is mostly H_2, while with low charging rates it is approximately half H_2 and half O_2. When batteries are charged steadily the ratio of H_2 to O_2 is less than 2 to 1, but when they are given rest periods during the charging process the ratio of H_2 to O_2 is greater. AUTHORS.

1824. E.M.F. Correction in Electrochemical Cells for Metal/Metal Potential. E. Lange and K. Nagel. *Zeits. f. Elektrochem.* 42. *pp.* 50–65, *Feb.*, 1936.—The paper deals with the errors in the e.m.f. of electrochemical cells caused by the neglect of the potentials between metal/metal. F. J. B.

1825. First Dissociation Constant of Carbonic Acid at Different Temperatures. Y. Kauko and J. Carlberg. *Zeits. f. phys. Chem.* 176. *Abt.A.* 1. *pp.* 11–19, 1936.—CO_2 99·5 % pure is passed through solutions of $NaHCO_3$, of concentrations ranging from 5×10^{-5} to 10^{-1} mol./l. The H-ion concentrations, pH value, are determined by potentiometric methods, employing the quinhydrone electrode, and the glass electrode, and by colorimetric methods. The first dissociation constant and the solubility of H_2CO_3 at a pressure of 1 atmosphere are calculated from the experimental results by aid of the Debye-Hückel theory. The values agree well with those obtained by Kendall. F. J. B.

1826. Electrolytic Formation of Persulphate. Part I. R. Matsuda. *Chem. Soc. Japan, Bull.* 11. *pp.* 1–7, *Jan.*, 1936. *In English.*—The author describes a series of experiments on the electrolysis of solutions of H_2SO_4 and $(NH_4)_2SO_4$ to ascertain the influence of current density and OH-ion concentration. The influence of various kations, *e.g.*, H·, K·, NH_4·, Na·, Li·, Mg··, Zn··, Fe···, Al···, Cu··, and Cd··, is studied and the effects of some are explained to have connection with persulphate formation. The author suggests that the rôle played by the OH-ion will clearly account for the results. H. H. Ho.

***1827. Electrolytic Preparation of Deuterium. M. P. Appleby and G. Ogden.** *Chem. Soc., J. pp.* 163–168, *Jan.*, 1936.—A method for the preparation of D_2 by the electrolysis of 5 % NaOH solution is developed. The cell embodies the three important principles (*a*) the metal used for the electrode material must be a poor catalyst for the exchange reactions; (*b*) the evolved H_2 must be removed as quickly as possible from the electrode surface; (*c*) local concentration of DHO at the electrode surface must be avoided. The cell is water-cooled to 13–15° C. during the electrolysis and the electrodes are pure nickel. The separation coefficient used is that employed by the earlier workers in this field, *viz.*, concentration of D_2 in gas phase, concentration of D_2 in liquid phase, and at low concentrations of D_2O very much lower values for the separation coefficient are obtained with this cell than the values predicted by various workers. F. J. B.

1828. Nature of Overvoltage and Electrolytic Separation of Hydrogen Isotopes. J. Horiuti and G. Okamoto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 616. *pp.* 231–242, *Feb.*, 1936. *In English.*—Two experimental lines of investigation are followed (1) the determination of the reaction velocity, overvoltage and current on an anodically polarised H-electrode of Ni, and (2) the electrolytic separation factor. The separation factor is determined for Ni, Au, Ag, Pt, Hg and Sn, in the same solutions and at the same overvoltage. A mechanism for the catalytic and electrochemical reactions is proposed. F. J. B.

1829. Electrolysis of a Solid Gold-Copper Alloy. G. Nehlep, W. Jost and R. Linke. *Zeits. f. Elektrochem.* 42. *pp.* 150–153, *March*, 1936.—A current passed through a Au-Cu alloy wire is found to bring about transport of material. Au is concentrated at the anode and copper at the kathode. The transport number of Cu is found to be approximately $7{\cdot}4 \times 10^{-11}$ at 1000° Abs. F. J. B.

1830. Standard Electrode Potential of Lithium in Methyl Alcohol. A. Macfarlane and H. Hartley. *Phil. Mag.* 20. *pp.* 611–616, *Oct.*, 1935.—Amalgam electrodes show anomalous behaviour in dilute solution, hence measurements cannot be extended to sufficiently dilute solutions for an independent evaluation of the activity coefficients of the electrolytes. It is assumed that the activities of LiCl and HCl in dilute solutions of the same concentration are equal, and with amalgam electrodes in the cell 0·35 % Li amalgam | LiCl in CH_3OH | Ag Cl Ag measurements give − 3·095 volts for the standard electrode potential. Values are given of this potential for Li, Na, Tl, H, Ag, I, Br, and Cl in CH_3OH, C_2H_5OH and water, and for the observed and calculated partial molal free energies of transfer of a number of electrolytes between infinitely dilute solutions in these solvents. The limitations of Born's equation for the calculation of free energies of transfer are discussed. N. M. B.

1831. Platinum Electrode. A. Šlygin and A. Frumkin. *Acta Physicochimica*, 3. 6. *pp.* 791–818, 1936. *In German.*—The dependence of the p.d. metal/solution is investigated for a platinised Pt electrode, in solutions of H_2SO_4, HCl, NaOH, HBr, Na_2SO_4, NaCl and NaBr. The p.d. is shown to depend upon the quantity of electricity passed in the region between the potential of the H electrode and anodic polarisation of about 1 V. The curves of potential and quantity of electricity passed show that in the case of anodic polarisation, the quantity of electricity passed is at first used in effecting a desorption of the adsorbed H_2. This is followed by a rapid change of potential, and finally by oxidation of the electrode. The effects of different methods of platinising the electrodes upon the form of the curves are also determined. F. J. B.

1832. Electrode Potential of Iron and Hydrogen-Ion Concentration. J. W. Shipley and J. H. Shipley. *Canad. J. of Research*, 14. *Sect.A. pp.* 31–40, *Jan.*, 1936.—When No. 30 iron wire, 99·8 % pure, is immersed in buffer solutions, sharp breaks of about 0·75 V in each case, occur in the potential (measured against a calomel electrode and uncorrected for liquid junction potentials) at definite pH values; between 3·1 and 4 for phosphate, between 4·3 and 4·6 for borate, and between 10·1 and 10·9 for citrate solutions. Apparently the "final" potential, sometimes established only after immersion for days, is determined solely by the electrolyte, being unaffected by cleaning the wire with emery, or by treatment beforehand with passivating agents, or by bubbling H_2 or O_2 through the solution. Addition of 0·25 % NaCl causes irregularities in the pH–E curves, the breaks are ill-defined and occur at lower hydrion concentrations. Corrosion was inappreciable in phosphate and borate buffers above 6·7 and 4·6 pH respectively. Below the breaks continuous general corrosion takes place, above them only local attack, accentuated by the common salt impurity introduced. To explain these results the existence of a non-conducting film is assumed. D. R. H.

1833. Polarisation at the Ferri-Ferro Electrode. W. L. H. Moll. *Zeits. f. phys. Chem.* 175. *Abt.A.* 5. *pp.* 353–358, 1936.—The investigation of the electrolysis of ferric and ferrous salt solutions with Pt and Au electrodes shows no overvoltage on freshly prepared electrode surfaces. If the electrodes are in contact with the electrolyte for some time, polarisation occurs. The polarisation can be reversed by anodically or kathodically loading the electrodes until gas evolution begins. F. J. B.

1834. Kathode Effect in the Electrolysis of Cadmium Salts. O. Kudra. *Zeits. f. phys. Chem.* 175. *Abt.A.*5. *pp.* 377–382, 1936.—It is shown that under certain conditions, and at certain current densities at the kathode, the separation of spongy Cd does not take place until after an interval of time has elapsed after switching on the current. This interval of time is found to be independent of the concentration of the solution at a constant current density. An equation is evolved for the calculation of the time interval, but it is shown that the anions present in the solution are not without influence on the kathode effect. The possibility of using the equation for the rapid estimation of Cd salts is indicated. F. J. B.

1835. Kinetics of Processes at the Iron Anode of a Galvanic Element. W. Roiter and W. Jusa. *Acta Physicochimica,* 4. 1. *pp.* 135–144, 1936. *In German.*—The polarisation of the iron anode of the galvanic element Fe | $FeSO_4$ | Hg_2Cl_2 | Hg is studied for both commercial and electrolytic zinc. The apparatus is described and curves of the results are given. It is shown that the relation between $\Delta\epsilon$ and I is well represented by the equation $\Delta\epsilon = abI/(1 + bI)$. The similarity of the given equation to the Langmuir adsorption isotherm equation is emphasised. R. L.

1836. Polarisation Discharges in Multiple Electrode Systems. H. Hunt, J. F. Chittum, and H. M. Grubb. *J. Phys. Chem.* 40. *pp.* 239–245, *Feb.,* 1936.—Currents produced in an electrolytic solution by the presence of polarised electrodes are discussed. The importance of considering them when dealing with electrolytic phenomena is pointed out. AUTHORS.

1837. Polarometric Titrations. V. Majer. *Zeits. f. Elektrochem.* 42. *pp.* 120–123, *March,* 1936.—The name polarometric is given to the type of electrometric titrations depending on the sudden polarisation (or depolarisation) of the indicator electrode at the end-point, which is thus characterised by a sudden fall (or rise, respectively) of the current strength. In this theoretical paper it is pointed out that the method may be extended to precipitation and neutralisation titrations. By choosing a suitable constant polarising potential a dropping mercury electrode can be made to act as a specific indicator for particular molecular or ionic species. [See following Abstract.] L. A. W.

1838. Polarometric Precipitation Titrations with Dropping Mercury Electrode. V. Majer. *Zeits. f. Elektrochem.* 42. *pp.* 123–127, *March,* 1936.—The author's polarometric method [see preceding Abstract] is applied to the precipitation titrations of barium chloride or lead nitrate with sulphuric acid or potassium sulphate and the reverse. The experimental arrangement, which employs a dropping mercury electrode, is described and curves of current against quantity of reagent added are given for various polarising potentials. In the theoretical part the equations for these curves are deduced and compared with observation. L. A. W.

∗ **1839. pH Measurements with the Glass Electrode in Unbuffered Solutions. K. Schwabe.** *Zeits. f. Elektrochem.* 42. *pp.* 147–150, *March,* 1936.—A special form of glass electrode is designed for the determination of pH values in unbuffered solutions. The measurements are carried out by a simple compensation measurement of the e.m.f. The pH values for $N/1000$ acetic acid and $N/1000$ succinic acid are determined by the method, employing a buffer solution in the glass electrode of pH = 3·0. [See Abstract 4377 (1935).] F. J. B.

1840. Effect of Temperature on Ionisation Constants of Dibasic Acids. I. Jones and F. G. Soper. *Chem. Soc., J. pp.* 133–137, *Jan.,* 1936.—The ionisation constants of a number of symmetrical dibasic acids are determined electrometrically in cells without liquid junctions, and the effect of temperature on the constants is investigated over the range 25° to 74° C. E. R.

1841. Effect of Pressure and of Temperature upon the Change of Volume accompanying Electrolytic Dissociation. E. Brander. *Soc. Scien. Fennica, Comm. Phys.-Math.,* 8. 17. [10 *pp.*], 1935.—The author has shown that the change of volume of an aqueous solution owing to dissociation of the dissolved electrolyte, is, given by $\triangle v\,(p) = -\,2\,\mathrm{RTA}/(1 + \mathrm{A}p)$, where $\triangle v\,(p)$ denotes the change of volume at pressure p and temperature T; A is the constant in the compressibility equation of water, *viz.*: $\log\,(1 + \mathrm{A}p) = \mathrm{B}\,[\{v(1)/v(p)\} - 1]$. Values of A at temperatures between 0° and 80°, and of $\triangle v$ at 0°, 20°, 60° and 80° C. are tabulated for pressures between 1 and 3000 kg./cm^2. The results are also expressed graphically. The results are compared with those derivable from an application of Planck's formula, *viz.*, $d \log k/dp = -\,\triangle v/\mathrm{RT}$. Satisfactory agreement is found for values of A, relating to acetic acid, derived either from data relating to compressibility of water or the electrical conductivity of the acid. J. S. G. T.

1842. Activity of Hydrogen Ions. Y. Kauko and J. Carlberg. *Soc. Scien. Fennica, Comm. Phys.-Math.* 8. 23. [7 *pp.*], 1936.—It is shown that the pH values for solutions are in error by an amount depending upon the error in value of the pH for the comparison solution. The incorrect value for the pH of acids leads to a wrong value for the dissociation constant. The dissociation constant of the acid can be obtained from the measurement of the electrical conductivity and the correct value for the pH of the comparison solution can be obtained from the incorrect value of the dissociation constant measured by potentiometric methods. The pH value for the Viebel solution (0·01 *N* HCl + 0·09 *N* KCl.) obtained by careful measurements in bicarbonate solutions is: 18° − 25° C. pH = 2·08, and 0° C. pH = 2·09. F. J. B.

1843. Diffusion Potentials and Ionic Activities. J. J. Hermans. *Zeits. f. phys. Chem.* 176. *Abt.A.* 1. *pp.* 55–64, 1936.—This paper is a criticism of a recent publication by Z. Szabó [see Abstract 4373 (1935)]. It is emphasised that the e.m.f. of a liquid cell depends on diffusion potentials and ionic activities and that the latter can only be determined when the former are accurately known. For this purpose the Nernst formula $\epsilon = (l_1 - l_2)\,\mathrm{RT}\log c/(l_1 + l_2)\,\mathrm{F}$ is inexact since it does not take into account interionic forces, and the corresponding limiting correction for infinite dilution is $\epsilon = (l_1 - l_2)\,\mathrm{RT}\,(\log c + \mathrm{A}\sqrt{c})/(l_1 + l_2)\,\mathrm{F}$, where A is a constant to be calculated from the data. It is shown that this correction is invalid for ordinary cells. Szabo (*loc. cit.*) has recently published very exact potential measurements for the cells: $\mathrm{Pt/H_2, HCl}\ m_1\mathrm{/HCl}\ m_2\mathrm{, H_2/Pt}$ (25°), and $\mathrm{Hg/HgCl, HCl}\ m_1\mathrm{/HCl}\ m_2\mathrm{, HgCl/Hg}$ (25°), but his conclusions based on the earlier theories are now disputed on the ground of incorrect calculation of diffusion potentials and ionic activities. The author calculates the diffusion potential of a single electrolyte taking into account the interionic forces and thence the activity, and by means of his results indicates where Szabó's conclusions are invalid. H. H. Ho.

1844. Electrolytic Polishing of Copper. P. Jacquet. *Comptes Rendus,* 202. *pp.* 403–404, *Feb.* 5, 1936.—The action is due to the formation of a poorly conducting layer of liquid in contact with the copper surface to be polished; the thickness of this layer is necessarily greater over the hollows, thus causing the action on the projections to be greater. The uselessness of $\mathrm{HPO_3}$ in this process is due to the insolubility of $\mathrm{Cu(PO_3)_2}$ as compared with $\mathrm{Cu_3(PO_4)_2}$ or $\mathrm{Cu_2P_2O_7}$ in the acid fluid. [See Abstract 853 (1936).] C. A. S.

See also Abstracts 1408, 1767, 1771, 1814.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

*****1845. Electrophysics. N. Campbell.** *I.E.E., J.* 78. *pp.* 186–193, *Feb.*, 1936.—This paper is a review of progress in many branches of physics since 1932, when the last review was presented. It embraces nuclear physics, such as the discovery of the positive electron, or positron, and the suggestion of the existence of a neutral analogue of the positron and negatron, the "neutrino," to explain the failure of the principle of the conservation of energy in β-ray radioactivity; nuclear spin; the new "heavy" elements; cosmic rays; "coincidence" Geiger counters; the metallic state ; the production of low temperatures; supraconductivity and the applications and advances made in electron oscillographs and microscopes. A. C. W.

1846. Rayleigh's Theory of Perturbations. J. Winter. *J. de Physique et le Radium,* 6. *pp.* 516–520, *Dec.*, 1935.—If a spectral problem is solved for a Hamiltonian H_0, a solution can be attempted for a neighbouring value $(H_0 + H_1)$. The author studies the convergence for various approximations. In order to do this, H_1 has to be given special forms. In real physical problems, H_0 and H_1 are given by the problem. The particular problem studied is the diffraction of electrons, regarded as de Broglie waves. The treatment is compared with that in which the perturbation theory of Born is used. A. C. M.

1847. Diffraction of Fast Electrons by Rock-Salt. S. G. Pinsker and L. I. Tatarinova. *Phys. Zeits. d. Sowjetunion,* 8. 6. *pp.* 602–625, 1935. *In German.*—By investigation of the diffraction of fast electrons by NaCl preparations, crystallised from solutions of different concentrations (1 %, 0·5 %, 0·2 %), it is found possible to observe the transition from the normal Debye pattern (1 %) to the point electronogram, which corresponds to single crystal diffraction. Intermediate types show the Debye rings, with single points irregularly distributed over the pattern. Discussion of the point interference patterns enables an explanation to be given of a number of the principal questions relative to the geometrical development of electron refraction. [See also Abstract 3641 (1935).] A. W.

1848. Scattering of High-Energy Protons in Hydrogen. M. G. White. *Phys. Rev.* 49. *pp.* 309–316, *Feb.* 15, 1936.—Over 7000 photographs of high-energy proton tracks in H_2 were taken and the observed frequency of scattering is compared with Mott's wave-mechanical treatment. For energies less than 600 kV the angular distribution is found to agree with theory to within a rather large statistical fluctuation. Anomalies are found for protons of incident energies exceeding 600 kV, *e.g.*, there is about ten times too much scattering in the range 40°–45°. As Mott's formula is based on the assumption of Coulomb forces, experiment seems to indicate a departure from the inverse square law for high energies. For a classical distance of closest approach of 6×10^{-13} two protons can no longer be treated as point charges, whereas on classical grounds there should be no difficulty down to 1/1846 the electron radius or 10^{-16} cm. C. J. B. C.

1849. Scattering of Positrons by Electrons with Exchange on Dirac's Theory of the Positron. H. J. Bhabha. *Roy. Soc., Proc.* 154*A*. *pp.* 195–206, *March* 2, 1936.—The ordinary collision of an electron with a positron, and the consequent scattering is considered on the Dirac theory of the positron. It is shown that exchange may take place between the electron we initially observe, and one of the virtual electrons in states of negative energy, and that this exchange very considerably modifies the scattering. It is further shown that an alternative way of looking at this exchange is to consider the process as one in which the initial electron and positron have been annihilated, giving rise simultaneously to a new pair. The ordinary scattering must then be modified on any theory in which the electron and positron can be created and annihilated in pairs. The practical result of the extra scattering is that when positrons pass through matter, the number of slow secondary and ionisation electrons produced is not changed, but the number of fast secondary electrons is considerably increased for high initial energies of the positron. AUTHOR.

1850. Annihilation of Positrons. J. C. Jaeger and H. R. Hulme. *Cambridge Phil. Soc., Proc.* 32. *pp.* 158–160, *Jan.*, 1936.—The paper deals with the annihilation of positrons by a process in which only one quantum of light is emitted. The treatment of the problem by Solomon [see Abstract 2255 (1935)] and others is discussed. The authors take the case of a unit stream of positrons incident on a single Pb atom and calculate the number σ annihilated per second by the two electrons of the K-shell. The values of σ are much less than the values of the cross-section σ_0 as calculated by the Born approximation method, and reasons for this are put forward. W. E. P.

1851. Effective Diameter in Ionic Collisions with Resonance Excitation. F. Wolf. *Ann. d. Physik*, 25. 6. *pp.* 527–544, *March*, 1936.—Previous work is extended [see Abstract 4705 (1935)] to the examination of ionic collisions for accelerating potentials between 30 and 1030 V for $He^+ \rightarrow Ne$, A; $Ne^+ \rightarrow He$; $H_2^+ \rightarrow He$, Ne, A. In general, the curves show the same characteristics. The effective diameter at first falls rapidly with increasing ionic velocity to a minimum and then increases slowly; theoretical considerations show that this is to be expected. The effective diameter, particularly at great velocities, is extremely small compared with that derived by means of the kinetic theory. In the case of $Ne^+ \rightarrow He$, the nucleus may approach to within 3/10 of the kinetic theory distance without appreciable effect. A resonance curve is constructed and it is found that, with few exceptions, the resonance principle is valid. H. J. H. S.

1852. Theory of the Kikuchi Lines. M. v. Laue. *Ann. d. Physik*, 25. 6. *pp.* 569–576, *March*, 1936.—It is shown that the Kikuchi lines can originate from scattering with loss of energy at electrons which are bound to definite atoms, whereas conduction electrons will not give rise to such lines in the scattering process. C. B. A.

1853. Shot Effect of Secondary Emission. M. Ziegler. *Physica*, 3. *pp.* 1–11, *Jan.*, 1936. *In English.*—The secondary current from an electrode bombarded by primary electrons can be represented by the series $\sum_0^\infty n(n\beta_n\bar{I}_{pr})$, where $\beta_n\bar{I}_{pr}$ is the fraction of the primary current whose electrons each set free n secondary electrons ($\sum^\infty n\beta_n = 1$). It is assumed that the primary shock and the secondary emission are practically simultaneous, so that the n secondary electrons set free by the same primary electron can be considered as a single " electron multiple " so far as they are concerned in producing current fluctuations. From the known formula for the shot effect it can then be shown that the total fluctuations of secondary current are proportional to $\sum_0^\infty n(n^2\beta_n\bar{I}_{pr})$. From this theory it is shown that in a triode where the grid and anode are positive with respect to the kathode and can each emit secondary electrons, and where the densities of the charges between the electrodes are negligible, the difference $(I_g - \overline{I}_g)^2 - (I_p - \overline{I}_p)^2$ of the current fluctuations at grid and anode should be proportional to the difference $(I_g - I_p)$ of these currents. This conclusion has been confirmed by experiments, details of which are given. Further work will be described in a subsequent paper. A. W.

∗1854. High-Speed Kathode-Ray Oscillograph. J. Stekonikow and Slaschew. *Techn. Phys., U.S.S.R.* 2. 6. *pp.* 507–521, 1935. *In German.*—A description is given of a h.v. kathode-ray oscillograph having a high writing speed. The author claims that it is much simpler in construction and use than other oscillographs of much smaller writing speed. With accelerating voltages of the order of 10–20 kV the writing speed attained is in the neighbourhood of 100 km./sec., the voltage sensitivity under these conditions approximating to 10–15 V per mm. deflection. An oscillograph having two streams of kathode rays is also described, and records showing simultaneously an impulse and a sinusoidal wave of frequency 10^6 p.p.s. are reproduced. A. B. W.

∗1855. Sensitive High-Power Cold-Kathode Oscillograph for Low Exciting Potential. E. Westermann. *Arch. f. Elektrot.* 30. *pp.* 109–122, *Feb.* 18, 1936.—The construction and operation are described of a new oscillograph of the cold-kathode type for low exciting potentials of the order of 10 to 15 kV. The oscillograph has a narrow metal discharge tube and with potentials of the above order very high current densities in the electron beam are obtained. Examples are given of oscillograms obtained by means of an external camera with the new oscillograph and these show that the instrument possesses the high sensitivity hitherto obtainable only with oscillographs of the hot-kathode type, while retaining the high recording power of the cold-kathode type. A. W.

∗1856. High-Vacuum Kathode-Ray Oscillograph. O. S. Puckle. *Journ. Sci. Instruments,* 13. *pp.* 78–82, *March,* 1936.—An instrument is described, containing several special features, which has been designed to permit investigations to be made over an extremely wide range of frequencies. AUTHOR.

∗1857. High-Speed Simultaneous Recording System for Two Kathode-Ray Oscillographs. C. S. Hallpike. *Journ. Sci. Instruments,* 13. *pp.* 92–95, *March,* 1936.—Optical and mechanical methods are described which have been employed for continuous simultaneous recording upon 35-mm. bromide paper from two l.v. kathode-ray oscillographs. Paper speeds used range from 1/25 in. to 30 ft. per sec. At this latter speed satisfactory images are obtained at electron gun voltages not exceeding 800. The temporal resolution obtainable at this speed permits the reading of time intervals of 0·2 millisec. AUTHOR.

See also Abstracts 1428, 1790, 1794, 1801, 1888.

ELECTROSTATICS.

1858. Contact P.D. between Silver and Barium. External Work Function of Silver. P. A. Anderson. *Phys. Rev.* 49. *pp.* 320–323, *Feb.* 18, 1936.—Surfaces of very pure Ag and Ba are procured by distillation in a gettered vacuum. Alternate films are subjected to electron bombardment as in a previous experiment [see Abstract 3647 (1935)] for finding contact potentials between W and Ba. Ba surfaces are reproducible to ± 0·001 V and Ag surfaces to ± 0·02 V. The contact potential Ag-Ba at liquid-air temperature is 1·94 ± 0·02 V, this gives the external work function of micro-crystalline Ag at $4{\cdot}33 \pm 0{\cdot}05$ equivalent volts as compared with 4·08 V. determined thermionically and 4·74 V photoelectrically. These results can only be systematically compared when the variation of work function with temperature and with crystal surface structures are determined. H. M. B.

***1859. Increased Voltage of van der Graaff Electrostatic Generators. F. Joliot, M. Feldenkrais and A. Lazard.** *Comptes Rendus,* 202. *pp.* 291–292, *Jan.* 27, 1936.—The presence of CCl_4 vapour in the surrounding atmosphere greatly increases the maximum potential to which the sphere can be raised. Thus, with a sphere 1 m. dia. in a room of 300 m^3. capacity, the vaporisation of 1l. CCl_4 raises the maximum possible voltage from 650 to 1250 kV, at which potential sparks passed to the walls. [See Abstracts 2052 (1933) and 865 (1936).] C. A. S.

See also Abstract 1797.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

See Abstract 1864.

MAGNETISM AND ELECTROMAGNETISM.

1860. Electromagnetism Independent of Metrical Geometry. Part V. D. van Dantzig. *K. Akad. Amsterdam, Proc.* 39. 1. *pp.* 126–131, 1936.—On the basis of the author's theory of electromagnetism [see Abstract 894 (1935)] the fundamental equations of quantum-electrodynamics are now developed. The commutability-relations for light waves are deduced by a simpler method than has been given hitherto. The essential equations are also shown to be integral, and not differential, equations. G. C. McV.

1861. Temperature Dependence of Spontaneous Magnetisation. K. Honda and T. Nishina. *Zeits. f. Physik,* 98. 11–12. *pp.* 657–665, 1936.—The variation of the residual magnetism of iron single crystals with temperature is measured for the three principal axes. Since the result of these measurements is widely different from the known temperature dependence of induced magnetism it is considered that the so-called temperature dependence of spontaneous magnetisation is certainly not real, but only induced magnetisation. A. W.

1862. Analysis of Dynamic Curves of Magnetic Permeability and of Iron Losses. W. Arkadiew. *Comptes Rendus,* 202. *pp.* 39–41, *Jan.* 6, 1936.—The eddy currents which develop in sheet-iron and Fe wires during magnetisation in alternating fields lower the permeability of the material by the absorption of energy. This phenomenon is studied theoretically for the case of constant permeability (weak fields). A contribution is made for the case when the permeability is not constant. Experimental curves obtained by Wilson for frequencies of $9{\cdot}9 \times 10^4$ to $1{\cdot}5 \times 10^6$ per sec. are analysed by a method devised by the author [see Abstract 3817 (1933)]. In this frequency range the permeability falls progressively from 220 to 100, being 160 at 6×10^5 per sec. The energy consumption is a maximum at the latter frequency. H. J. H. S.

1863. Mathematical Expression for the Hysteresis Curve. J. Neufeld. *Comptes Rendus,* 202. *pp.* 125–126, *Jan.* 13, 1936.—Starting with an expression for B which contains a term depending on the instantaneous value of H, and a term which represents the hereditary action of hysteresis, a functional relation is found which expresses the hysteresis cycle. G. E. A.

1864. Experiments in Strong Magnetic Fields. O. v. Auwers. *Naturwiss.* 24. *pp.* 65–73, *Jan.*, 31, 1936.—A review is given of the investigations of P. Kapitza during the last few years in strong magnetic fields, including: (1) the study of change of resistance in the magnetic field; (2) Measurements of magnetic susceptibility, intensity of magnetisation, and magnetostriction in strong fields, including observations on paramagnetic and diamagnetic substances; (3) observations on magnetism at very low temperatures—in liquid H_2 and He. J. J. S.

1865. Magnetic Powder Experiments on Rolled Ni-Fe. J. L. Snoek. *Physica*, 3. *pp.* 118–124, *Feb.*, 1936. *In English.*—The magnetic powder patterns obtained by Bitter [see Abstract 5241 (1932)] on the surface of molten unstrained ferromagnetic bodies are briefly described and their origin is discussed. It is suggested that two phenomena are present—one due to inhomogeneities in the material and the other to the magnetic state of the material and the magnetisation process. The latter is investigated by studying the powder figures and the magnetisation curves of a 50 % Ni-Fe alloy in the annealed state (" isotropic " specimen), and in the untreated condition (" anisotropic " specimen). Marked differences are observed between the two. The general properties of the Bitter patterns are described; the most important of these is that the lines are parallel to the direction of easiest magnetisation. H. J. H. S.

1866. Technical Problems in Ferromagnetism in Weak Fields. R. Goldschmidt. *Helv. Phys. Acta*, 9. 1. *pp.* 33–41, 1936. *In German.*—The essential properties of a magnetic material for use in weak fields are outlined and, in illustration, a number of magnetisation curves in low fields are given for several magnetic alloys of industrial importance. The hysteresis loops of all the alloys are similar in type, their characteristics being governed by the Rayleigh formula $B = (\mu_0 + 2\nu H_1)H \pm \nu(H^2–H^2)$, where μ_0 is the initial permeability, ν the hysteresis factor, H_1 the maximum field strength and H the field strength corresponding to an induction B. Measurements of permeability and hysteresis loss in weak alternating fields by Jordan, Gans, Becker and others show a linear correspondence between permeability and loss and the amplitude; for finely divided materials, the loss increases approximately with the frequency. These results may be derived from Rayleigh's formula. Measurements on magnetic losses near the Curie point are described and the results discussed theoretically. A description is given of a number of results obtained by the author with high Si transformer sheet-iron. H. J. H. S.

1867. Magnetic Behaviour of Alums of the Iron Group. A. Siegert. *Physica*, 2. *pp.* 85–90, *Feb.*, 1936. *In German.*—The question is investigated whether the validity of the Bose-Stoner formula in the case of the alums of the different elements of the first half of the iron group may be explained by the presence of a field of force acting on the magnet-ion, the crystalline structure being assumed. This is found to be possible with Cr_{+++}, Mn_{+++} and Fe_{+++} if a potential of cubical symmetry is assumed. With Ti_{+++} and V_{+++}, however, it is necessary to postulate deviations from cubical symmetry. G. E. A.

1868. New Alloys with High Coercive Force. W. Jellinghaus. *Zeits. f. techn. Physik*, 17. 2. *pp.* 33–36, 1936.—The Fe-Pd, Fe-Pt and Co-Pt alloys containing 50 % (atomic) of each constituent, with or without special heat treatment, form ordered solid solutions (super-lattice) as the result of a transformation in the solid state. High values of coercive force were observed in these alloys, apparently associated with the appearance of the super-lattice. The highest value measured was 4000 oersteds in 50 % Co–Pt, the corresponding product B_2H_0, being 12 × 10^6, *i.e.* 3 times as great as for Mishima Ni–Al steel. The magnetic properties of these alloys resemble those of " dispersion-hardened " alloys, but the atomic diffusion necessary is much less and the probability of the formation of transformation-nuclei is therefore high. The high coercive force is difficult to explain by intercrystalline stresses, but is probably due to interaction between the different kinds of atom. C. E. W.

***1869. Determination of Magnetisation-Coercive Force. C. W. Davis and M. Hartenheim.** *Rev. Sci. Instruments*, 7. *pp.* 147–150, *March*, 1936.—Attention is directed toward the difference between induction-coercive force and magnetisation-coercive force. Although the former is used more commonly the latter appears to have a more fundamental significance, so that a consideration of its meaning has led to a rapid, direct method for determining coercive force. An apparatus is described with which this method is used to determine rapidly the coercive force of solid and granular samples. Advantages of this method and apparatus are discussed. AUTHORS.

1870. Diamagnetism of Heavy Water. O. Specchia and G. Dascola. *N. Cimento*, 12. *pp.* 606–609, *Dec.*, 1935.—Quincke's method is used to find the susceptibility of heavy water because only small quantities are available. The susceptibility is found to decrease as the temperature increases being analogous to ordinary water. Such a diamagnetic anomaly is interpreted by the hypothesis of the presence of polymerised molecules. H. M. B.

1871. Temperature Dependence of the Susceptibility of Oxygen. H. Lues. *Zeits. f. Physik*, 98. 9–10. *pp.* 537–547, 1936.—Measurements of the susceptibilities of O_2 between 286 and 600° Abs. show increasing deviation from the χT = const. law with increasing temperature. W. R. A.

1872. Magnetic Susceptibility Measurements on Oxygen and the Rare Gases. K. E. Mann. *Zeits. f. Physik*, 98. 9–10. *pp.* 548–558, 1936.—Between 1800 and 15,000 oersteds the specific susceptibility of O_2 is independent of the field strength. The specific susceptibility from 20 to 100° C. is constant to within 1 % for the range of field strengths and for pressure between 90 and 750 mm. The susceptibilities of Ne, A, Kr and Xe are 6·75, 19·54, 28·02, and 42·40 × 10^{-6} respectively. These results are discussed in relation to previously determined experimental values and to values calculated from theoretical considerations. W. R. A.

1873. Paramagnetism of Nickel Alloys. C. Manders. *Ann. de Physique*, 5. *pp.* 167–231, *Feb.*, 1936.—Magnetic susceptibility/temperature relations are obtained for solid solutions of some metals in Ni. In most cases the susceptibility follows the relation $\chi = a + C/(T - \theta)$. a, C, and θ are calculated for the alloys. [See following Abstract.] W. R. A.

1874. Magnetic Properties of the Metallic State and Energy of Interaction between Magnetic Atoms. L. Néel. *Ann. de Physique*, 5. *pp.* 232–279, *Feb.*, 1936.—The results of Manders [see preceding Abstract] are interpreted. The number of magnetic electrons remains constant in passing from the ferro- to the para-magnetic state. The energy of magnetic interaction between two neighbouring atoms is defined and calculated for various types of bodies. Reasons for the peculiar magnetic properties of Pt are suggested. W. R. A.

1875. Action of Alternating and Moving Magnetic Fields upon Particles of Magnetic Substances. H. S. Hatfield. *Physics,* 7. *p.* 55, *Feb.,* 1936.—A reply is made to certain criticisms by C. W. Davis [see Abstract 3178 (1935)] of a paper by the author on the Mordey effect [see Abstract 3934 (1934)] and a number of additional observations are described which amplify the author's explanation of the effect. H. J. H. S.

1876. Alternating Fields in Saturated Solid Iron. G. Haberland and F. Haberland. *Arch. f. Elektrot.* 30. *pp.* 126–133, *Feb.* 18, 1936.—A theoretical investigation by a simple, but exact method, of the field and flux distribution in solid masses of iron subjected to a sinusoidal applied field, assuming a completely saturated condition. Curves of time-variation of eddy-currents and of flux density show wide departures from a sine-wave. For the same flux density at the surface, the magnetising current is 53 % less, the power loss 70 % greater than that calculated assuming constant permeability. The effect of hysteresis is calculated, assuming a rectangular loop similar to that for a single crystal, and is found to be a reduction in the total power loss, the diminution in the Joulean loss more than compensating for the loss due to hysteresis. C. E. W.

1877. Combinations of Circular Currents for Producing Uniform Magnetic Fields. L. W. McKeehan. *Rev. Sci. Instruments,* 7. *pp.* 150–153, *March,* 1936.—The theory of magnetic field production by a limited number of circular current loops with a common axis is briefly restated. The previously known particular solutions for two, four (or three), six and eight loops are recomputed and some new solutions of special interest are given. Expansions of surface zonal harmonics and of their first derivatives, up to the twelfth order, are included. AUTHOR.

***1878. Magnetic Measurements at Low Flux Densities Using the A.C. Bridge. V. E. Legg.** *Bell System Techn. J.* 15. *pp.* 39–62, *Jan.,* 1936.—A *résumé* is given of the basic relations between the magnetic characteristics of the core of a coil and the inductance and resistance of the coil as measured on an a.c. bridge. Modifications of the simple relations to take account of the interactions of eddy currents and hysteresis in the core material are developed, and are seen to require a more complicated interpretation of the data in order to obtain an accurate separation of the eddy-current, hysteresis and " residual " losses. Means are described of minimising or eliminating the disturbing effects of distributed capacitance leakance and eddy-current loss in the coil windings. Essential details of the a.c. bridge and associated apparatus, and of the core structure, are given. AUTHOR.

1879. Eddy Currents in Composite Laminations. E. Peterson and L. R. Wrathall. *I.R.E., Proc.* 24. *pp.* 275–286, *Feb.,* 1936.—The familiar theory of eddy-current shielding leads to an expression for the impedance of a ferromagnetic core inductance coil in terms of the initial permeability and resistivity of the core material, the core geometry, and the measuring frequency. Measurements on a number of different core materials over a wide frequency range have revealed sizeable deviations from the theory in some cases. The discrepancies are especially marked in some specimens of Cr permalloy, the measured inductance over a certain frequency range being of the order of one-tenth that specified by the theory. Discrepancies appear to arise when the laminations are not homogeneous, a condition contrary to an assumption of the simple theory. The inhomogeneity takes the form of a thin surface layer which has a permeability much less than that of the interior. By etching off these surface layers, the initial permeability is increased, and discrepancies between the measured variations of impedance with frequency, and those calculated for a homogeneous sheet are removed almost completely. The theory is extended to take account of the surface layers, and agrees well with measurements on the original unetched laminations when plausible assumptions are made regarding the properties of the surface layer. AUTHOR.

***1880. Iron-Free Coil for the Production of Strong Magnetic Fields. G. Gerloff and E. Löwe.** *Zeits. f. Physik,* 98. 9–10. *pp.* 559–560, 1936.—Two types of coil of simple construction are described for the production of an extended homogeneous field of 5000 oersteds or more. The coil is water cooled and carries a continuous current of 60–80 A. The field distribution in one of the coils is given. H. J. H. S.

See also Abstracts 1425, 1503, 1618, 1619, 1621, 1629, 1631, 1634, 1635, 1809, 1822, 1890.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1881. Influence of Atmospheric Electricity on Biological Phenomena. G. Kunze. *Gerlands Beitr. z. Geophys.* 46. 3. *pp.* 291–300, 1936.—A complete survey is made of previous researches on the effects of atmospheric conditions on biological activity. A periodicity of 5¼ days is found in the chemical activity in dog muscle and is connected with a similar periodicity in the reception of electromagnetic waves which is peculiar to the 10 m. wave band. J. E. R.

1882. Direct Measurement of Lethal Current for Paramecium Candatum. B. Luyet. *Comptes Rendus,* 202. *pp.* 511–512, *Feb.* 10, 1936.—Previous workers on the lethal current for *paramecium candatum* have observed the current through the medium surrounding the organisms and not in the organisms themselves. By cultivating the microbes in capillary tubes it is possible to pass the current directly. Currents greater than 1·4 μA always cause instantaneous death; with currents less than 0·2 μA this never happens. With intermediate currents the time between the application of the current and the resulting death varies from 0 to 30 sec. J. E. R.

***1883. Aids to X-Ray Stereoscopy. I. S. Hirsch.** *Radiology,* 26. *pp.* 234–236, *Feb.,* 1936.—A stereoscope is briefly described, but well illustrated and a method of determining the size of the phantom images seen by aid of the instrument, in respect to actual size, is detailed. The image seen can be viewed by magnification, which permits the detection of very small areas of calcification, of importance in the diagnosis of brain tumours. A method of plastic reproduction of the image, as viewed by the instrument, is also briefly described. B. J. L.

***1884. Cones and Other Collimating Devices for X-Ray Therapy. Edith H. Quimby and L. D. Marinelli.** *Radiology,* 26. *pp.* 16–26, *Jan.,* 1936.—In X-ray therapy the use of cone or cylindrical collimators attached to the X-ray tube is becoming more general, since such use assures that the patient does not change his position during treatment and there is better control of the beam of radiation. Such attachments may reasonably modify the quality of the radiation applied and the changes are investigated by the authors at 165 and 200 kV, by the aid of a mesh ionisation chamber. Data are given regarding the best method of filtration, the effect of distance from the mouth of the collimator in respect to ionisation measurements, the effect of the collimator upon the quality of radiation, and the distribution of the beam of radiation within the tissues. It is found, to remove the soft radiation produced by scattering upon the cone material 0·3 mm. aluminium plus a sheet of paper, or 1·5 mm. of celluloid or bakelite is required with lead cones. For bakelite cones, only used for localisation, no filter is required if they are least 15 cm. long. Use of bakelite or organic material at the mouth of the cone decreases the depth dose administered and is to be discouraged and, if used, the ionisation chamber used for calibration should be placed very close to it. The primary filter should always be at the top of the cone to avoid the effect of scattering. Cylindrical collimators give only negligible scattering which is about 2 % for lead and 4 % for bakelite. With a bakelite cone the amount of radiation which passes *via* its walls is relatively negligible and the use of cones of such like materials, for directing purposes is satisfactory. With lead cones the use of a limiting diaphragm at the top, to define the X-ray beam, is unnecessary and results in decrease of radiation administered. The material of the cone has no appreciable effect upon the quality of the total radiation passing through it and the spread of the beam within the tissues is not markedly greater when the limiting diaphragm is omitted. B. J. L.

1885. Separate and Combined use of Artificial and Natural Rays. W. H. Cameron. *Am. J. of Roentgenology and Radium Therapy,* 35. *pp.* 96–99, *Jan.,* 1936.—Discussion with respect to the therapeutic value of radium radiation, *i.e.,* produced by natural radioactivity and X-rays produced by electrical means. The author, who applies radium radiation in medical practice, is largely in favour of its preferential use, although the advantages of X-ray irradiation are largely omitted. B. J. L.

OSCILLATIONS AND WAVES.

1886. Motion of Electrons in Electric and Magnetic Fields Taking into Consideration the Action of the Space Charge. S. J. Braude. *Phys. Zeits. d. Sowjetunion,* 8. 6. *pp.* 667–674, 1936. *In English.*—In a previous paper [see Abstract 4412 (1935)] the authors examined the problem of the motion of electrons in crossed electric and magnetic fields, for the plane condenser. The present paper concerns the same problem for a cylindrical condenser. An equation is developed which can be solved approximately to give (*a*) the potential distribution, (*b*) the paths of the moving electrons and (*c*) the distribution of the space-charge density in the condenser. The method of solution is given. Finally the results are compared with experimental values for various magnetrons given by Slutzkin and Steinberg [see Abstract 2573 (1929)] and satisfactory agreement is found. G. E. B.

***1887. Generation of Oscillations in the Decimetre Wave Region. E. C. Metschl.** *Naturwiss.* 24. *pp.* 97–102, *Feb.* 14, 1936.—The principal methods hitherto employed for generating oscillations in the decimetre wave region are reviewed, their main features being compared from the point of view of efficiency, convenience and power output. A. W.

***1888. Oscillograph Amplifiers. M. v. Ardenne.** *Wireless Engineer,* 13. *pp.* 59–64, *Feb.,* 1936.—Describes a resistance-capacity valve amplifier using screened-grid valves that give a constant amplification of 1:2000 at all frequencies from 0·2 to 3×10^6~. A second amplifier with a higher overall amplification 1:100,000 within the limits of 0·2 to 2×10^4~, for electro-acoustical and physiological purposes is also described. E. W.

1889. Wave-Length and Potential Measurements with Lecher Wire System with Variable Wave Resistance. N. N. Malov. *Phys. Zeits. d. Sowjetunion*, 8. 6. *pp*. 595–601, 1935. *In German*.—The theory applicable to a Lecher wire system, consisting of two parts with different wave resistances, is developed and the appropriate formulæ derived. Application of such a system to potential and wave-length measurements is described and tests carried out show good agreement with theory. A. W.

1890. Some Equivalence Theorems of Electromagnetics and Their Application to Radiation Problems. S. A. Schelkunoff. *Bell System Techn. J.* 15. *pp*. 92–112, *Jan*., 1936.—After a review of the general aspects of the classical electromagnetic theory several " equivalence " theorems are established and illustrated with a number of examples from the diffraction theory. Then follows a discussion of possible applications of these theorems to radiation problems. The latter part of the paper is devoted to the calculation of the power radiated from an open end of a coaxial pair. AUTHOR.

1891. Audibility of Short-Wave Signals from Different Districts. K. Stoye. *Hochfrequenztechn. u. Elektroakustik*, 47. *pp*. 21–22, *Jan*., 1936.—A very large number of observations were made in Germany in the early part of 1935 of the audibility of short-wave signals from the U.S.A., which in a diagram is divided into nine districts. The waves used were in the two bands 20·8 to 21·4 m. and 41·0 to 42·8 m. Further diagrams show the signal strength of transmissions on these wave-lengths from each of the nine districts, on a large number of days during March, April and May, 1935. The results are correlated with magnetic disturbances and are discussed with reference to the 27-day solar cycle. [See following Abstract.] A. W.

1892. Audibility of 10-m. Waves and Solar Phenomena. K. Stoye. *E.N.T.* 13. *pp*. 17–20, *Jan*., 1936.—An account is given, with diagrams, of observations of the reception of waves of about 10 m., the observations covering the period from 1928 to 1935. The results show a definite connection with solar activity, the time of maximum sunspots corresponding with a reduced curvature of the wave path and hence an increased dead zone and the time of minimum sunspots with increased curvature and a reduced dead zone. For waves between 8·5 m. and 3 m. it is also found that the greater the time distance from the period of minimum sunspots the greater are the ranges possible with these waves. [See preceding Abstract.] A. W.

1893. Demodulation of Radio Bradcast Signals for Use as Sources of Constant H.F. Currents, L. G. Hector and H. L. Schultz. *Rev. Sci. Instruments*, 7. *pp*. 139–143, *March*, 1936.—Many radio broadcasting transmitters are equipped with modern temperature-controlled crystal-controlled oscillators so that these sources of a.c. of constant h.f. would be readily available for use in laboratory measurements were it not for the presence of modulation by programme material. Two methods for removing this modulation are described. The first employs an oscillator type of circuit actuated by the incoming radio signal. It has the virtue of simplicity, but is not stable in operation. The second method employs a demodulating amplifier that delivers to a low-loss tuned circuit pulses of energy that are almost independent of the modulation. This circuit is stable and does not require adjustment after once having been put in operation on a signal of given frequency. Distorted wave-forms appear only when the radio broadcast signal carries modulation approaching or exceeding 100 %. AUTHORS.

1894. Diffractive Propagation of Radio Waves. B. Wwedensky. *Techn. Phys. U.S.S.R.* 2. 6. *pp.* 624–639, 1935. *In English.*—Starting from the work of Watson and Laporte, a formula for the diffraction field of a Hertzian dipole situated on the earth's surface is derived. By means of this formula, which constitutes an extension of that of Eckersley, the propagation of radio waves round the earth can be calculated, taking into account the earth's resistivity but neglecting the effect of the atmosphere. The condition that the curve should pass asymptotically into the Sommerfeld-van der Pol curve for a flat earth is fulfilled for the two cases computed ($\lambda = 1550$ m. and $\lambda = 5$ m., sea water), whilst Eckersley's curve only satisfies this condition for $\lambda = 1550$ M. The calculations with the new formula are more complex than with Eckersley's formula, since in the former account is taken of the relation between the amplitude and the conductivity. A. W.

1895. Absorption of Electromagnetic Waves in the Ionosphere. I. Ranzi and C. Savorelli. *N. Cimento,* 12. *pp.* 610–615, *Dec.,* 1935.—During the daytime waves of 70–100 m. are reflected from the E-layer of the atmosphere, about 120 km. in altitude ; but about sunset echoes are received from the higher F-level. Observations of the echoes are made and it is found that when the scale of frequencies is extended to longer wavelengths the echoes from F are more intense. The hypothesis proved by this is that if the gradient of ionic density increases with height in E, the less should be the ionisation at the lower part of E and the waves should suffer greater absorption there. H. M. B.

1896. The D-Layer. P. Syam. *Indian Journ. Phys.* 10. *pp.* 13–21, *Jan.,* 1936.—The author discusses the existence of an absorbing layer—the so-called D-layer—situated below the E-layer of the ionosphere at a height of about 55 km. Radio echoes detected from such a low equivalent height furnish the direct evidence of the existence of the D-layer. Other evidences of indirect nature discussed are (*a*) the limited frequency band for reflection from the E-layer during daytime and (*b*) decrease of the recorded equivalent height of the E-layer at the approach of sunset. The phenomenon of the limited frequency band is considered in detail, and it is shown that the failure to obtain echoes during daytime with waves below a certain frequency can only be explained as due to absorption by an ionised layer distinct from and lying below the E-layer. It is also shown, by considering reflection from the E-layer boundary having a linear, parabolic or exponential ionisation gradient, that the absorption of waves during daytime cannot be explained as due to reflection from a diffuse E-layer boundary. The apparent decrease of the E-layer equivalent height is explained as due to the gradual disappearance of the D-layer with approaching sunset. The D-layer, when present, increases the group retardation of the exploring waves passing through it. AUTHOR.

1897. Reflection Coefficient of the Ionosphere for Radio Waves. F. W. G. White and L. W. Brown. *Roy. Soc., Proc.* 153*A*. *pp.* 639–660, *Feb.* 1, 1936.—Measurements of the reflection coefficient of the ionosphere for radio waves were made, using the technique of Breit and Tuve, the sender-receiver system being calibrated so that the reflection coefficient could be determined, for waves within the range of 2·80 to 6·50 Mc/s, from the relative amplitudes of the direct and the singly reflected waves. The method of calibrating the system is described. Examples are given of measurements, made at noon during the period November, 1934, to May 1935, showing the variation of the reflection coefficient with wave frequency. These examples show that the total absorption suffered by the waves depends very much upon the critical phenomena at the transition of reflection from one region to another. The influence of the absorbing regions is estimated. Using as a basis Appleton's theoretical formula, estimates are made of the collisional frequency of the electrons with gas molecules in the F_2-ionised region of the ionosphere. This frequency is of the order of 5×10^3 per sec. at a height of approximately 250 km. Some indication of the variation of this quantity with altitude is given. [See also Abstracts 4999 (1934) and 4224 (1935).] A. W.

1898. Absolute Method of Measuring the Dynamic Resistance of a Resonant Circuit. M. Boella. *Alta Frequenza*, 4. *pp.* 647–656, *Dec.*, 1935. *English Abstract.*—The definition of the dynamic resistance of a resonant circuit and the theory of the method of measurement are dealt with. The dynamic resistance is shown to be equal to the variation of the capacitive reactance necessary to reduce to $1 : \sqrt{2}$ the resonance value of the voltage of the resonant circuit, while this is inductively coupled to a constant frequency generator. Some practical information about the realisation of the measurement circuit is given, and the possible causes of errors are mentioned and discussed. Finally, the possibility of applying this method to the absolute measurement of high resistances at very high frequencies is pointed out. AUTHOR.

1899. Measurement of the Dynamic Resistance of a Resonant Circuit. M. Ferrario. *Alta Frequenza*, 4. *pp.* 657–667, *Dec.*, 1935. *English Abstract.*—After some general remarks on the measurement of the dynamic resistance of a resonant circuit by means of the dynatron, the results of experimental work for determining the sensibility and precision of the method and the practical limits of application with reference to the values of frequency and resistance are described. In order to examine its behaviour at very high frequencies, this method was compared with an absolute one, based upon a reactance variation measurement. The comparison proves that the dynatron method is suitable only up to 3000 ∼, whilst at higher frequencies the errors increase so rapidly that they reach 20 % and more at a frequency of 18,000 ∼ for a dynamic resistance of 20,000 Ω. The interpretation of the probable causes of the error is given, and the possibility of reducing it with a properly constructed screened-grid is suggested. AUTHOR.

See also Abstract 1773.

PIEZOELECTRICITY.

*1900. **Piezoelectric Relays. J. Gruetzmacher.** *Arch. f. Elektrot.* 30. *pp.* 122–126, *Feb.* 18, 1936.—When a piezoelectric crystal is electrically excited at one of its resonant frequencies, the relatively large oscillations give rise to large potential gradients in the air gap. The upper electrode, instead of being fixed, is connected to a spring, and, when the potential gradient exceeds a certain value, it becomes attracted towards the crystal by the electrostatic forces, thereby breaking or making a contact. Application to wireless control is suggested. P. V.